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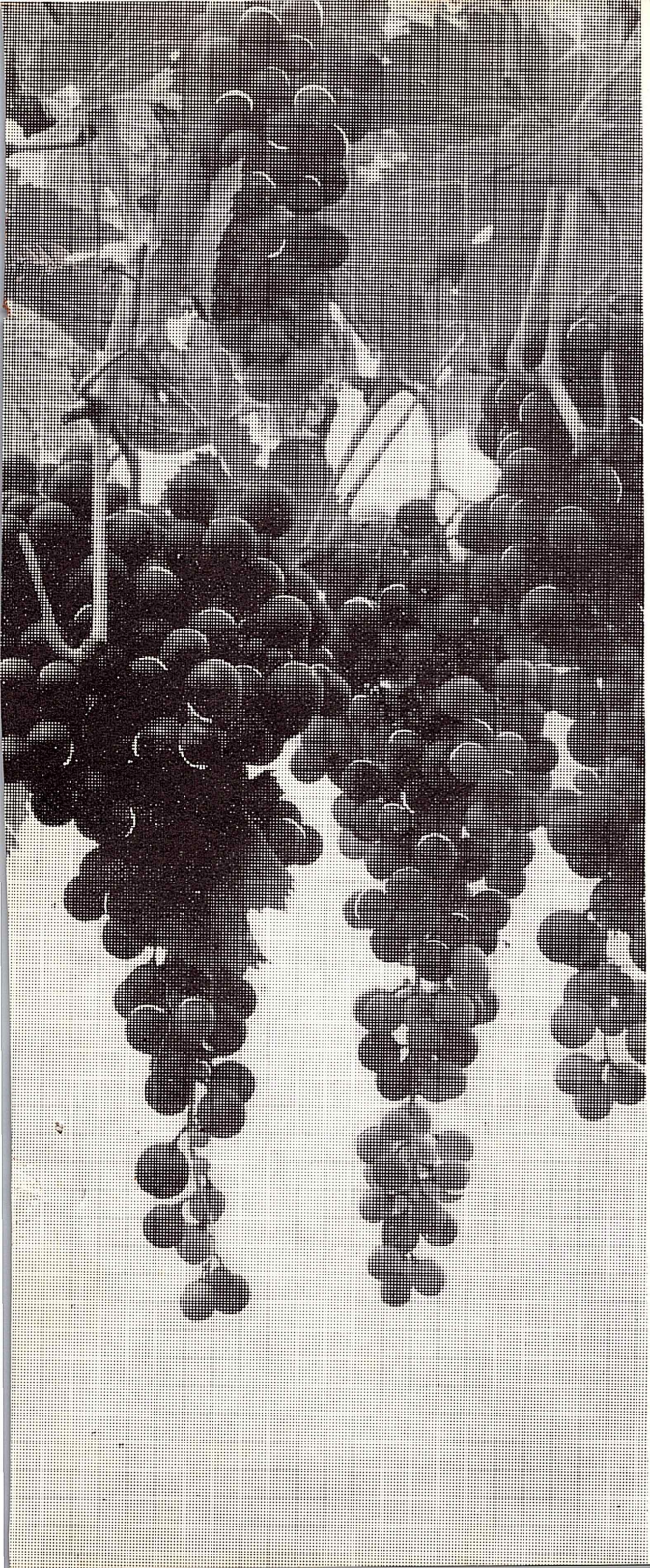
VITICULTURE

NEW ZEALAND DEPARTMENT OF AGRICULTURE BULLETIN 354



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Above—The Mission Vineyard at Greenmeadows, the oldest vineyard in New Zealand. It was established in 1865.

[*News-Photo*

Below—Large Hawke's Bay vineyards.

VITICULTURE

by

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A. R. Shearer, Government Printer,
Wellington, New Zealand, 1970

First Printed 1952
Revised 1958, 1963, 1970

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INTRODUCTION

The first grape vines were planted in New Zealand at Kerikeri in 1819 and later at Waimate, by a missionary, the Reverend Samuel Marsden.

James Busby, a notable pioneer of viticulture in Australia, planted vines at Waitangi when he came to the Bay of Islands in 1833 as official British Resident.

In the South Island early French settlers established some vineyard plots at Akaroa.

In 1898 the Government established an agricultural experimental station at Te Kauwhata, which later directed investigations mainly into growing fruit trees and grape vines. This Station eventually specialised in experimental work in viticulture and wine making and, over the years, has distributed many thousands of cuttings of stock and scion varieties.

Nothing significant was achieved in commercial viticulture until about 1900, when several small vineyards were established in Auckland and Hawke's Bay. These areas are the main centres of viticulture today.

Further development was slow until the Second World War, when abnormally favourable trading conditions induced rapid expansion. Nevertheless, the viticultural industry in New Zealand is still on a very small scale compared with that in most other countries where grapes are grown.

The last detailed vineyard survey in 1965 showed the area in vineyards in New Zealand was 1,253 acres, an increase of 294 acres since the 1960 survey. The vineyard area is still rapidly expanding and in 1968 was estimated at 2,100 acres.

The 1965 survey shows that the ten main grape varieties, in descending order, were Baco 22A, Albany Surprise, Palomino, Seibel 5455, Riesling Sylvaner, Chasselas Dore, Pedro Ximines, Seibel 5437, Cabernet Sauvignon, and Pinot Meunier.

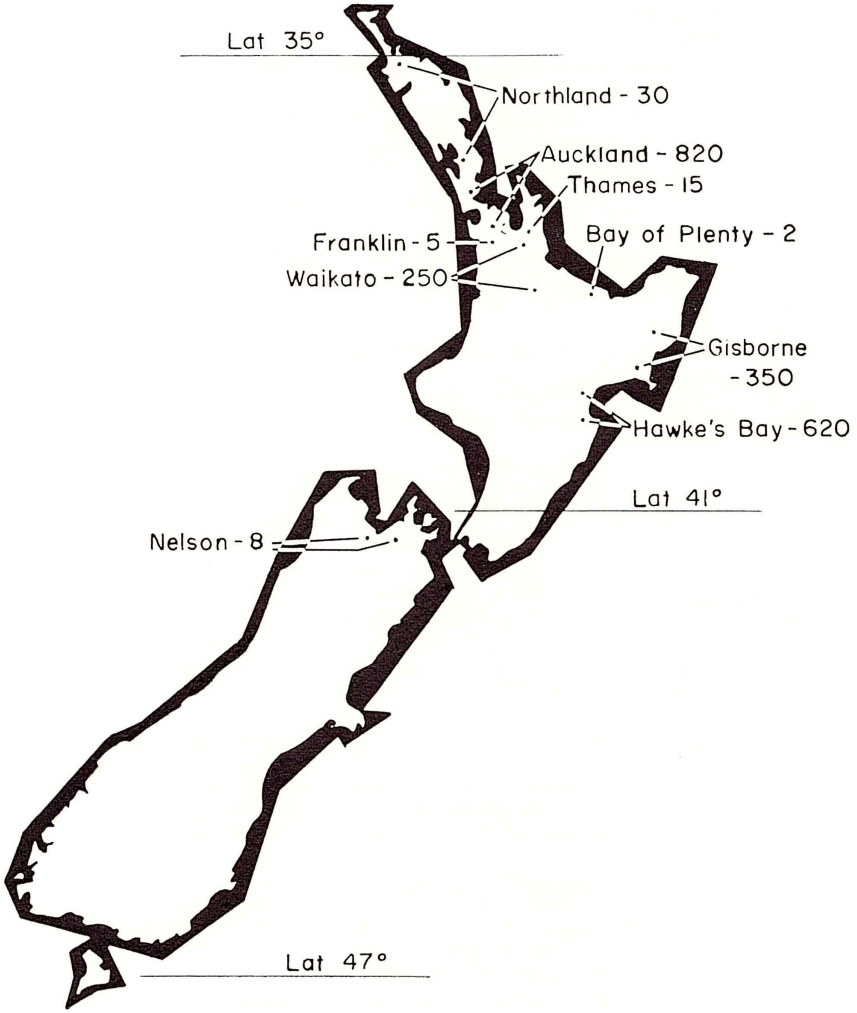
The destructive vine pest phylloxera was first reported in the Auckland Province about 1890. Until recently, Hawke's Bay has been free of the pest.

Viticulture is practised from latitudes 20 to 51 degrees in the Northern Hemisphere and from 20 to 40 degrees in the Southern Hemisphere. The latitudes of viticultural areas in the Southern Hemisphere are: Australia 32 to 38 degrees; South Africa 33 to 34 degrees; South America 31 to 34 degrees; New Zealand 36 to 40 degrees.

Because New Zealand is insular, its summers are cooler than summers in places on the same latitude in Australia. The viticultural belt north of the Equator extends further toward the cooler regions than does the belt in the Southern Hemisphere because of the moderating influence on climate of the Gulf Stream.

Viticulture may eventually become commercially practicable in selected positions in Canterbury and Otago, where success would be limited to the selection of suitable early-maturing varieties. Sprinkler irrigation now affords a proven counter to the erstwhile-limiting factors of late frost and inadequate rainfall in much of the South Island.

VINEYARD AREAS 1968 (in acres)
Total 2,100 acres



PROSPECTS FOR EXPANSION OF VINEYARDS

Wine Market

Thirty years ago more wine was imported than was made here, but now about seven times more wine is made than is imported. Import control since 1938 has been mainly responsible for this reversal.

Present production is somewhat inadequate to meet the buoyant market demand, particularly for higher grade wines, and the viticultural industry is extending plantings to meet the position.

The development of an export market for the higher quality New Zealand wines is considered a realistic move to stabilise and strengthen the economics of the industry.

Germany, despite a more difficult climate for grapes than New Zealand, and high production costs, has established a valuable export trade with white table wines. This has been possible because of the quality of the German wines.

Outdoor Table Grapes

Market prospects for well-grown outdoor table grapes appear favourable, as these grapes can be produced at about a third of the cost of glasshouse grapes.

Recent importations of new table grape varieties are under trial at the Te Kauwhata Viticultural Research Station. These varieties were selected for early cropping and hardiness and should greatly improve outdoor table grape production.

Grape Juice Production

The amount of grape juice made in New Zealand is very small. Grape juice is a wholesome and refreshing beverage, and would probably find a ready market in New Zealand.

For a balanced flavour the acidity of the grapes used should be reasonably high (0.9 percent to 1.2 percent as tartaric acid) and the sugar content moderate (18 percent to 22 percent). In the climate of New Zealand grapes ripen mostly with a good balance of sugar and acid for juicing.

Grapes for juicing should have a distinctive flavour. The Albany Surprise variety grown extensively in New Zealand is suitable. Albany Surprise is a Labrusca grape like Concord, which is the main grape juice variety in the United States of America. Muscat varieties used in a blend of suitable black grapes impart an attractive flavour.

LOCALITIES SUITABLE FOR VITICULTURE

In 1968 there were 2,100 acres of vines, all but 8 acres being in the North Island, along the east coast and north of Auckland.

The principal vineyard areas are Henderson (820 acres) and Hawke's Bay (620 acres). Present prospects are for a big expansion in the Gisborne district, which now has just under 400 acres of vineyards.

Prospects for viticulture are already known in areas where grapes have been grown, but in other districts an opinion on the prospects for viticulture must be based largely on climatic data.

The climatic factor of most importance for assessing the viticultural prospects of a region is the total amount of solar heat recorded over the growing season. The term "heat summation" is used to indicate the total amount of heat received above the minimum for active growth. Grape vines make practically no growth at temperatures below 50 degrees F, so the heat summation is calculated as the sum

of the mean daily temperatures above 50 degrees F over the October to April growing period in New Zealand. For example, if the mean temperature for November was 60 degrees F, the summation for that month would be 300 degree-days—10 degrees multiplied by 30 days.

The heat summations for viticultural regions throughout the world range from about 2,000 to 5,000 degree-days. Commercial grape growing is not known to be successful anywhere the heat summation figure is much below 2,000 degree-days.

Meteorological statistics show that the degree-days heat ratings for places that may be considered as possible viticultural areas throughout New Zealand range from 2,919 at Kaitaia, in Northland, latitude 35°04′, down to 1,615 at Alexandra, latitude 45°14′, in Central Otago. It appears that every degree of latitude in New Zealand accounts for a difference of about 100 degree-days in heat rating.

In Europe all viticultural regions with temperatures similar to ours specialise in producing light table wines. These regions include the northern provinces of France, the Rhineland in Germany, and the warmer parts of Austria, Czechoslovakia, and Switzerland.

The best of the heavier dessert and sherry wines are produced in warmer latitudes. Table wines are also produced in these warmer regions, but usually do not attain the high quality of the cooler latitudes.

In the grape-growing countries of Europe and elsewhere a significant proportion of the crop is marketed as table grapes. Only in the warmer latitudes, with heat ratings above 3,500 degree-days and a drier climate, are special grapes dried for raisins, sultanas, and currants.

In one of the most northerly vineyard regions of Europe, around Geisenheim, Germany, the heat summation is only 1,709 and the additional 300 degree-days needed to reach the minimum heat rating of 2,000 degree-days are gained in the sunny, sheltered situations of the vineyards. Thus, in similar instances of a low heat rating from the local meteorological records, viticulture could be successful on selected sites with somewhat warmer conditions than are general for the area.

Over the 212 days in the growth cycle of the vine in New Zealand, from October to April inclusive, a selected, sheltered site with a favourable sunny aspect could be 1.5 to 2 degrees F warmer than the meteorological recording site for the area, and thus gain an extra 300 to 450 degree-days for its heat summation.

On deep, friable soils a rainfall of about 12 in. during the growing season is adequate, if preceded by good winter rainfall of about 15 in. Of course, with adequate irrigation vines are independent of rainfall. Ideal rainfall conditions as harvest approaches in New Zealand are heavy rains in January and very little for the remainder of the season, as late rains will damage most grape varieties.

The following table shows the heat ratings, October-November frosts, and rainfall figures for several towns throughout New Zealand:

The table shows that the main areas of commercial production in the Auckland, Hawke's Bay, and Gisborne areas are likely to provide satisfactory conditions for increased grape production.

Other promising areas in the North Island are parts of Northland, Thames, Tauranga, Te Kauwhata, and Wanganui.

The most favourable localities in the South Island appear to be near Nelson (Appleby) and Blenheim, with possible suitable microclimates in Canterbury and Central Otago. Success in the south may be limited to the selection of suitable early-maturing varieties.

Location	Heat Ratings Degree-days	Days Ground Frost Days Screen Frost Oct	Nov	Feb	Rainfall (inches) Mar	Apl	Season	Year
Kaitaia	2,919	0.1	—	3.4	2.8	4.9	26.0	54.0
Lat. 35°04′		—	—					
Henderson	2,659	0.5	—	5.0	4.0	5.0	31.8	62.1
Lat. 36°54′		—	—					
Thames	2,876	0.2	0.1	3.8	3.6	4.3	26.2	49.6
Lat. 37°09′		—	—					
Tauranga	2,481	4.0	1.6	3.5	3.8	5.0	27.1	51.2
Lat. 37°40′		—	—					
Te Kauwhata	2,594	—	0.1	3.4	2.8	4.0	23.8	46.3
Lat. 37°25′		—	—					
Wanganui	2,227	0.2	0.1	3.0	2.2	2.8	19.5	34.4
Lat. 39°55′		—	—					
Gisborne	2,454	2.6	0.6	3.2	3.0	3.4	19.2	39.8
Lat. 38°40′		0.2	0.1					
Hastings	2,412	3.8	0.6	2.7	2.0	2.5	16.1	30.6
Lat. 39°39′		0.5	0.1					
Appleby (Nelson)	1,962	3.1	0.7	2.4	2.2	3.3	19.5	36.9
Lat. 41°17′		0.1	—					
Blenheim	2,040	6.5	1.6	1.9	1.6	1.9	13.6	25.8
Lat. 41°30′		0.5	0.1					
Christchurch	1,740	5.2	2.4	1.8	1.7	1.8	13.4	24.5
Lat. 43°29′		1.2	0.1					
Alexandra	1,615	12.9	6.0	1.4	1.3	1.3	9.4	13.2
Lat. 45°15′		1.9	0.2					

Acknowledgment

Meteorological data obtained from Department of Civil Aviation publications.

Most places in the North Island, particularly in the Auckland Province, are somewhat handicapped by the high rainfall during the critical grape-ripening period of February to April. This limits varieties to weather-resistant types for economic production.

Of the districts with a low rainfall during the grape-ripening period, Canterbury and Central Otago have a degree-days heat rating that is too low, and late spring and late summer frosts can also be a problem. Sprinkler irrigation for both irrigation and frost control and the location of vineyards in micro-climatic conditions with heat ratings higher than general, could lead to successful viticulture in carefully selected areas. However, it is unlikely that large-scale grape growing would be successful.

Days of ground frosts are recorded at ground level, and screen frost recordings are taken in a ventilated screen about 4 ft above ground. It can be seen from the climatic table how the incidence of frost is reduced at this slight elevation. For instance, at Alexandra the average number of frosts at ground level in October is 13, and on the screen the average is only two. In November the average number of frosts at ground level is six, whereas at screen level the average is only about one frost in 5 years.

High trellising could therefore reduce the risk of frost damage. In marginal viticultural regions in Europe the risk of frost damage is reduced and maximum heat obtained by establishing the vineyards in elevated positions on sunny hillsides.

Experimental vineyards at the Te Kauwhata Research Station. [*Sparrow*

VINEYARD ESTABLISHMENT

Selection of Site

The requirements of a vineyard site are sunny aspect, good drainage, and freedom from spring frosts. Winter frosts are beneficial to the soil and the vines, but a heavy frost on young growth in spring is disastrous.

Under the mild conditions of New Zealand it is important to use land with a northerly aspect to secure maximum sunshine. Gentle slopes are preferable because of the high cost of working and the soil-erosion associated with steep slopes. Steep slopes should be terraced by bulldozing before planting. Well drained, level land is quite suitable and easier to work.

Where the site is exposed to cold winds, suitable shelter belts should be planted as early as possible. Very dense shelter belts are undesirable, as they create a stagnant, humid atmosphere conducive to fungous diseases and by impeding air drainage may increase the possibility of frost damage.

Soils

Viticulture can be successful on a wide range of soil types. Least suitable are heavy clays, shallow soils, and poorly drained soils. Though good drainage is essential in areas of high rainfall, rather deep soils to hold moisture are necessary in areas of low rainfall.

Most of the vineyards in the Auckland province are on clay land; in Hawke's Bay they are on lighter soil.

Soils of moderate fertility, which promote medium growth and cropping, usually produce higher quality grapes than are produced on deep fertile soils, which support large vines with heavy crops. Generally, there is a proportionate place in the economy of any country for both low-priced, mass-produced, grapes of medium quality, and limited production of more costly, high-quality grapes.

Drainage

Proper drainage is essential, as vines are fairly intolerant of waterlogged conditions. Sometimes the laying of field tiles provides the only satisfactory solution, but a vineyard site should be selected where there is reasonably good natural drainage to avoid the high cost of tiling.

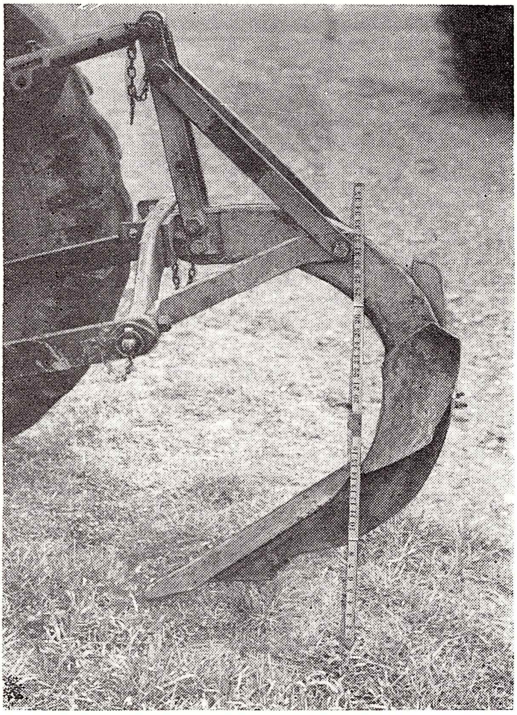
A fairly general practice in vineyards to assist drainage over winter is to plough on to the vines on both sides of the row, leaving a fairly deep furrow down the centre. This is done in autumn. In this way soil is mounded around the vines and excess water runs away down the centres of the rows.

Correct placement of the vine rows in relation to the contours of the land facilitates surface drainage. With such orientation the rows make a herringbone pattern with a slight fall to a headland down which the water escapes. Grassing down of the headland prevents scouring and soil erosion. If the soil is in a bad mechanical condition, no drainage scheme can be fully efficient.

Cover crops act as good dewatering agents, removing much surplus water, and their roots open up the soil and assist drainage.

Mole drainage has limited application and is not always successful. Unless extreme care is exercised in making mole drains, irregularities occur which form air locks and arrest the flow.

Useful results have been claimed on land with little natural fall by use of a subsoiling device fitted with a moulding attachment (see illustrations on next page).



Above and at right — A combined subsoiler and ridger used for improving drainage.

[*Sparrow photographs*

Water can run down this furrow deep into the subsoil, where it usually finds a natural watercourse.

The furrow is said to prevent the narrow opening made by the subsoiler from closing up, as organic matter from the topsoil washes down and keeps the opening porous to water.

Preparation of Land for Planting

The land may be prepared for planting in the following manner: deep plough and subsoil the area in autumn; then lime it and allow it to lie fallow over winter. In spring plough it again, returning the soil layers to their original positions, and follow this by discing and harrowing or rotary hoeing until the soil is broken down to a friable, loose condition.

It is usually desirable to have a soil analysis made to check pH and nutrient levels.

In heavy clay land an initial dressing of lime at the rate of at least 2 tons per acre will prove very beneficial in improving the soil texture.

When the area for planting is being marked out, a stake should be inserted at every position where a vine is to be planted and a sighting taken along and across the rows. It is only by sighting in conjunction with measurement that the land can be neatly and accurately plotted. The corner stakes are driven first, then the stakes round the perimeter, and the rest of the stakes aligned with these, a taut cord line being used for direction and a steel tape measure for the distances. Any irregularities are then corrected by sighting along the stakes. Usually about 16 ft is allowed at the headland for turning with implements. Hillsides should be planted across the slope to counter soil erosion. It is best to plant at an angle to the slope to give some fall for drainage. Large areas may be planted in a herringbone pattern with a fall to the headland between the blocks down which the drainage water has free flow.

The usual planting distance is 6 ft or 8 ft apart in rows 10 ft apart.

To find the number of vines required per acre at different planting distances, multiply the distance between plants by the row spacing and divide into 43560. For example, at 6 ft distance, $43560 \div 6 \times 10 = 726$ vines per acre. At 8 ft distance, $43560 \div 8 \times 10 = 544$ vines per acre.

Planting

Make holes, taking the stakes as centres, only sufficiently large and deep to take the vines. Large, deep holes are unnecessary if the ground has been properly cultivated beforehand. Even when a deep hole is filled, an unhealthy pocket of stagnant water will sometimes form at the bottom of it.

Plant the vines so that the bottom roots are no deeper than about 6 in. from the surface. Deeper planting places the roots in the colder, less-fertile soil layer near the subsoil and retards development.

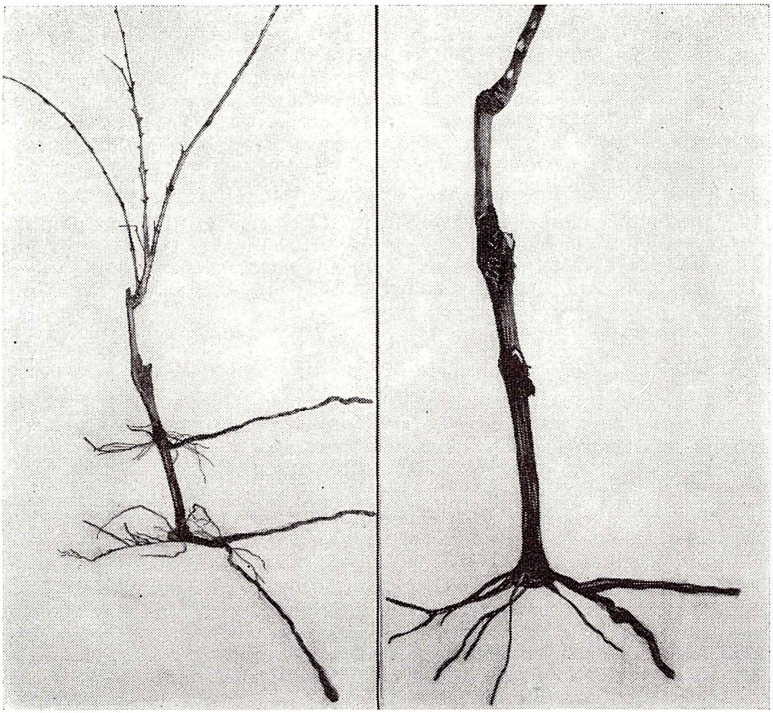
A grafted vine is prepared for planting by leaving only two buds on the strongest shoot and neatly cutting off the others. Only the roots at the base are left, and these are trimmed back to about 3 in. long. Any roots higher up are removed. The bottom of the grafted joint should be left about 1 in. above ground level. For filling in holes only topsoil should be used and the soil pressed firmly round the vines, particularly the roots.

The addition of manure to the soil used for filling in holes is not recommended. Apart from the fact that most manures are too severe

to be in direct contact with the young, tender roots, it is best to encourage the roots to go out in search of nourishment. It is preferable to run bands of blood and bone manure about 6 in. from the vines on either side of rows and lightly cultivate it in. After planting, the soil should be mounded up over the graft to allow for settling, and the stake replaced alongside each vine so that it can be secured to the stake to prevent wind damage. Growth lying on the ground is also liable to injury during cultivation.

For the first 2 years the vine is allowed unrestricted growth to encourage maximum root development, as any check to the foliage will also check the roots. Any suckers from the stock or roots from the scion should be removed. When first-year pruning is done all but the strongest cane is cut off and this is pruned back to two buds.

In the second year the trellis is usually erected and the growth trained and tied along the bottom wire. At the second pruning the strongest cane of each vine is retained to form the trunk and the others are removed. If the vine has made good progress up to this stage, the canes selected to form the trunk may be left extended along the bottom wire for about 2 ft to form a fruiting rod which will carry a small crop. Any fruit which may appear up to this time is removed so that all the energy of the vine is directed to root and wood development. At the third pruning two rods about 3 ft long are left on either side and in the

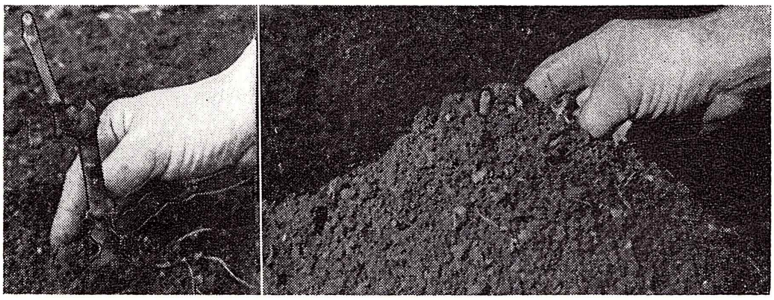


[*Sparrow*

▲ Cleft grafted rootling before being trimmed.

▲ The same vine prepared for planting.

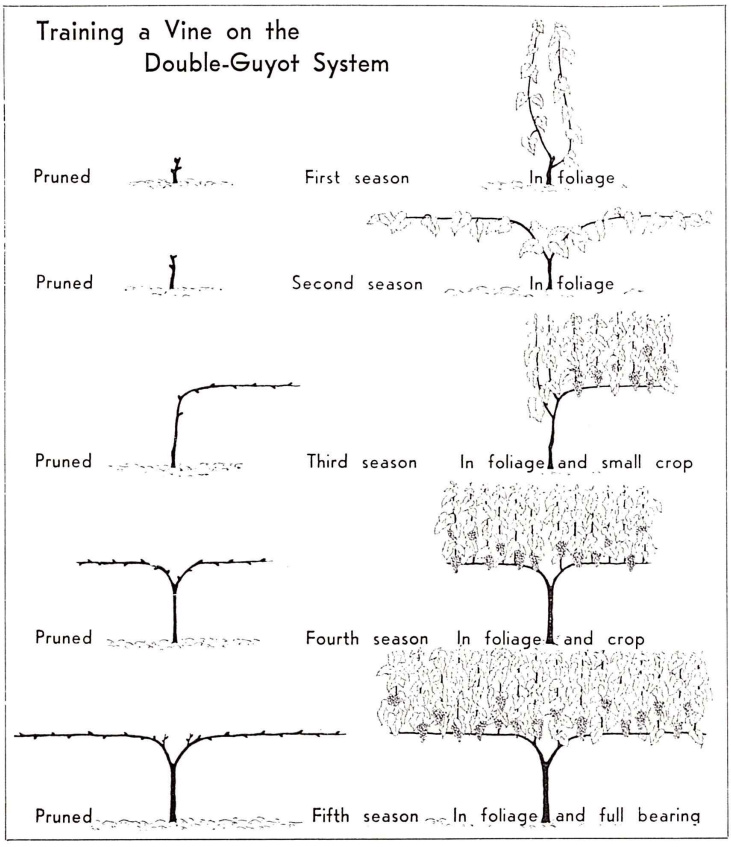
next year the vine is in full bearing, and pruning is carried out as described on pages 40-51. Training and pruning are illustrated below.



[*Sparrow*

▲ Grafted vine planted.

▲ Vine mounded over after being planted.



PHYLLOXERA-RESISTANT VINE STOCKS

The phylloxera insect kills ungrafted European vines and many hybrids by destroying the roots. Native American vine species are resistant to the pest. These resistant American species have been selected and hybridised to provide suitable phylloxera-resistant stocks for susceptible fruiting varieties.

Because of phylloxera infestation in all areas north of and including Hawke's Bay only vines which have been grafted on to phylloxera-resistant stocks should be grown in these parts.

The Grape-vine Diseases Regulations 1952 are designed to prevent the spread of phylloxera. Under these regulations it is illegal to send vines or vine parts outside the infested area unless accompanied by a Certificate of Sterilisation signed by an Inspector of the Department of Agriculture. The simplest method of sterilisation or disinfestation of phylloxera-suspect material is complete immersion for 10 minutes in a mixture of 1½ gallons of summer oil, 1 pint of nicotine sulphate, and 1 pint of detergent or spreader per 100 gallons of water.

Some of the factors considered in the breeding of stock were phylloxera resistance, ability of cuttings to root readily, affinity with European varieties, ability to promote fertility or yield, ability to grow in wet, cold soils or to withstand drought conditions, and lime tolerance. No one stock, of course, possesses all these properties, and stocks have to be selected to suit particular conditions. The more common stock varieties can be readily identified by the typical shape of the leaves.

The list on pages 78 and 79, extracted from the Yearbook of the United States Department of Agriculture, 1937, contains the names and characteristics of the native American vine species used in the breeding of fruiting and stock hybrids. *Vitis vinifera*, the species which includes all European varieties, is also included.

Mourvedre × *Rupestris* 1202

Mourvedre × *Rupestris* 1202 stock is used more than any other in New Zealand. The cuttings readily strike root and are easy to graft. It is a vigorous stock, having good affinity with most varieties and giving stronger vines in nearly all soils. It has proved sufficiently resistant to phylloxera, but in moist sandy soils it is susceptible to damage by eelworms. Its ability to grow in cold, heavy, clay soils has been an outstanding virtue in the Auckland and North Auckland areas. Vines grafted on to 1202 usually crop well, but are disposed to imperfect setting of the fruit. The mother vines used to obtain stock wood of this variety carry loose bunches of small purplish black grapes, a feature which assists identification.

Riparia × *Rupestris* 3306

Riparia × *Rupestris* 3306 is second in popularity in New Zealand. The cuttings root and graft well, though they are not quite equal to 1202 in this respect. The stock is well adapted to a variety of soils, including those with moderate alkalinity.

An outstanding quality of 3306 is its tolerance of cold, wet soils. It has good affinity with most *Vinifera* varieties and induces early ripening, good colour, and even setting of the fruit. It has ample vigour, though less than 1202.

Though 3306 does not usually promote as big crops on its scions as 1202, the fruit is generally superior in colour, sweetness, and set. This stock is a male plant and does not produce berries.

Berlandieri × *Riparia* 420A

Berlandieri × *Riparia* 420A is used to some extent in New Zealand, but is not as popular as 1202 or 3306 because of the inability of cuttings to form roots readily and the difficulty experienced in obtaining a good percentage of successful grafts. Young nursery vines on this stock transplant badly and seem to stagnate for about two seasons before making any headway. It is a poor stock in excessively wet soils. It is a male plant.

For these reasons 420A should be used only for field grafting and cannot be recommended as a good general-purpose stock.

It is a useful stock in rich soils where more vigorous stocks fail to induce proper setting of the fruit. As it has a longer growing period than many other stocks, it is capable of bringing the fruit to a more advanced stage of perfection if picking is left until late in the season. This stock or *Chasselas* × *Berlandieri* 41B should be used in limy soils, as *Berlandieri* stocks are resistant to lime chlorosis.

Berlandieri × *Riparia* 5BB

This rootstock is often listed as *Teleki-Kober* 5BB. It has been widely adopted in the cool marginal viticultural regions in Europe and should also be useful in New Zealand for promoting late-season ripening of many wine and dessert grapes.

Chasselas × *Berlandieri* 41B

Chasselas × *Berlandieri* 41B is among the best of the *Berlandieri* stocks. It has good affinity with most *Vinifera* varieties, promoting good crops and well-set bunches. Table varieties usually develop good colour on this stock. It grafts and transplants more successfully than 420A and is a good stock for muscat varieties, which are inclined to poor setting.

Influence of Stock on Ripening

Stocks with a dominant *Berlandieri*, *Monticola*, or *Cordifolia* character possess the property of carrying the maturation to an advanced stage late in the season. On the other hand, stocks with a dominant *Riparia* or *Rupestris* character have a shorter growing season, and though they induce earlier ripening, the fruit does not always reach the same degree of perfection as fruit picked at a later date on a stock with a longer growing period.

As the important thing in New Zealand is to bring the fruit to a passable stage of maturity and harvest it before wet weather sets in, early stocks are generally preferable. An exception could be made for certain varieties which can stand wet conditions to bring fruit to a more advanced stage of maturation. If cold weather occurs late in the season, no stock can contribute very much to further maturation of the fruit. The grapevine seems incapable of producing appreciable amounts of sugar at low temperatures, but a worth-while attenuation of acidity does occur even in cold weather at the end of the season, and this is of importance in wine making.

Riparia × *Rupestris* 3309

Riparia × *Rupestris* 3309 is a vigorous stock adaptable to a range of soil types. It is particularly useful in soils which dry out in summer, whether light or stiff clay, such as may occur in certain hillside positions or in porous volcanic soils. It is a male plant.

Solonis × *Riparia* 1616

Solonis × *Othello* 1613

Both these stocks are considered good stocks for poorly drained soils in Europe, but have not been tried to any extent in New Zealand. They are resistant to nematode damage and root rot infections.

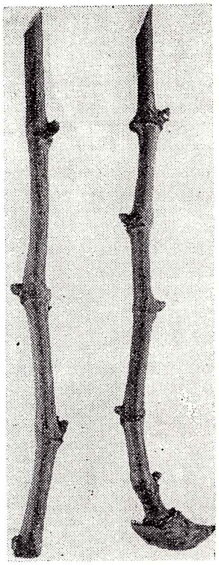
Other Stocks

Field trials in Australia on the performance of stock varieties indicated the following order of preference: (1) *Richter* 99 (for field grafting only); (2) A.R.G.I.; (3) 1202; (4) 420A (for field grafting only); (5) 3306; (6) *Rupestris du Lot;* (7) 3309; (8) 554-5.

For bench grafting, 1202 and A.R.G.I. stocks were superior to 3306, 3309, *Rupestris du Lot,* and others.

In France the most widely used stocks are *Rupestris du Lot* (syn. *Rupestris St. George, Rupestris Monticola*); *Riparia* × *Rupestris* 3309; *Riparia* × *Rupestris* 101.14; *Chasselas* × *Berlandieri* 41B; *Riparia* × *Berlandieri* 161.49; *Riparia* × *Berlandieri* SO4.

VINE GRAFTING



Vine cuttings prepared for planting.

There are many methods of grafting, but those to be described are recommended because of their simplicity and efficiency.

Nursery Grafting

In nursery grafting the stock cuttings are planted one season and grafted the next in a suitable nursery site, where the necessary attention can be given to weeding, watering, spraying, and manuring. After grafting, the vines are not transplanted in the vineyard until the following spring.

The nursery soil should be friable, fertile, and well drained, and prepared in advance for planting the stock cuttings. The nursery should be situated in a warm, sheltered position. In autumn the ground should be ploughed, limed, and allowed to lie fallow over winter. In spring the soil should be given a liberal application of blood and bone manure and sulphate of potash and worked to seed-bed condition by discing and harrowing or rotary hoeing.

The stock and scion cuttings are taken at the normal pruning time (June and July) and heeled in until required for planting or grafting. In grafting terms the root is called the stock and the fruiting member the scion. The stock cuttings are made of 1-year-old wood about 10 in. long from well-matured, healthy canes with a diameter slightly greater than that of a lead-pencil, preferably about $\frac{3}{8}$ in. Any thick canes with long internodes (spaces between buds) and any wood which is weak or appears immature should be rejected.

It is an advantage to leave a heel of old wood, as when this is done, cuttings root strongly from this heel and from the whorl of buds usually present at the base. (See the illustration on page 20.)

The prepared cuttings are tied in bundles, care being taken that none is upside down in relation to the others. Cuttings are heeled in by placing them in a trench, butts up, and covering them with a few inches of soil. A well-drained slope should be used for storing the cuttings, and the trench should be filled in with sand if the soil is heavy. Inverting the cuttings reduces any tendency for the top buds to show signs of growth prematurely. The scion cuttings are selected and treated in a similar manner to the stock cuttings, but the former are usually made longer and are stored flat. It is important to choose scion wood from healthy, productive, strong vines only. Stock cuttings are planted in the nursery in September and spaced about 9 in. apart with 2 ft between rows. This is a convenient working distance for weeding and grafting and allows the young vines sufficient scope for development.

The strike is improved by soaking cuttings upright in water for a day preparatory to planting. If the cuttings appear abnormally dry on dissection, they should be soaked for 2 days.

For planting a large number of stock cuttings a one-furrow plough can be used. The cuttings are placed upright against the shoulder of turned soil in the furrow. The soil is then pressed against the bases of cuttings with the foot and a second furrow is made to mound soil over the cuttings. Any irregularities are adjusted with a hand rake so that each top bud is covered with about 2 in. of soil. This will help to retard bud burst until root development has begun. Planted in this fashion the nursery will appear as a regular series of long, low mounds. After a time and when rain has fallen the earth will settle round the cuttings, leaving top buds exposed.

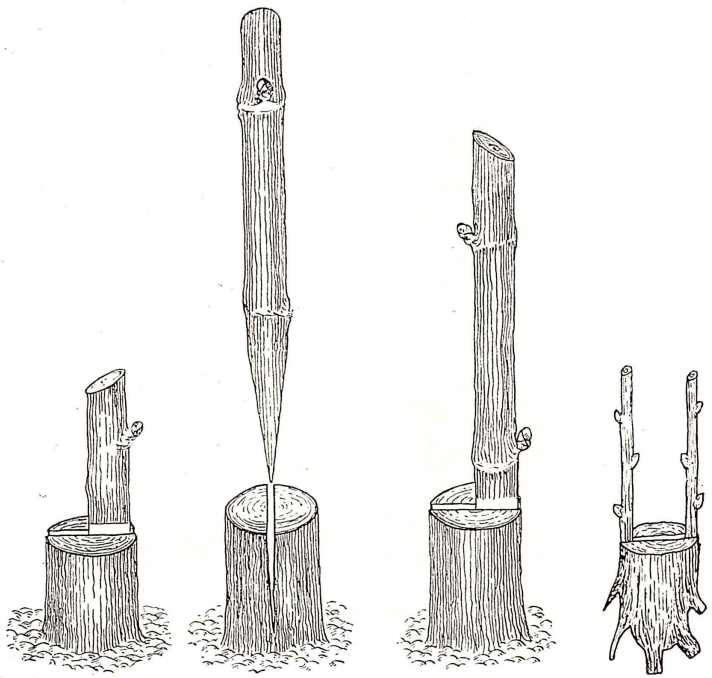
Grafting is done the following year in late September or early October, when the sap is moving strongly and the young leaves of the stock cuttings are about 1 in. in diameter. The surface soil is scooped aside, the vine decapitated below the top growth, and a single bud scion of the desired variety attached to the stock vine by a cleft or tongue graft. Any growth lower down is rubbed off.

Where stock and scion wood correspond in size a tongue graft, which gives a very neat union, is usually made. With stock and scion wood of unequal size a cleft graft is preferable. The grafter usually carries a number of scions, cut approximately to size with secateurs, wrapped in a damp cloth.

To make a cleft graft the stock is dissected squarely with sharp secateurs. The scion is reduced to one bud and tapered to a sharp wedge about 1¼ in. long. The vertical cut is made in the stock by a see-saw action with the knife and the incision held open to receive the wedge by the point. The handle of the knife can be used to tap the wedged scion into position; a final minor adjustment can be done by hand. It is essential that the bark of stock and scion are exactly in line on one side so that the cambium layers or the healing tissue between the bark and wood are in contact. (See the diagrams on page 22.)

With the tongue graft, slanting cuts on the same angle are made in stock and scion and in each surface an incision is made to form a tongue by which stock and scion are united. (See diagram page 24.) The length of the cut surface should be about three times the diameter of the wood and made with a quick, sliding movement of the knife. The tongues are started about a third of the way along the taper from the sharp end and are cut down across the grain until they penetrate about a third of the length of the cut surface. The tongues are opened

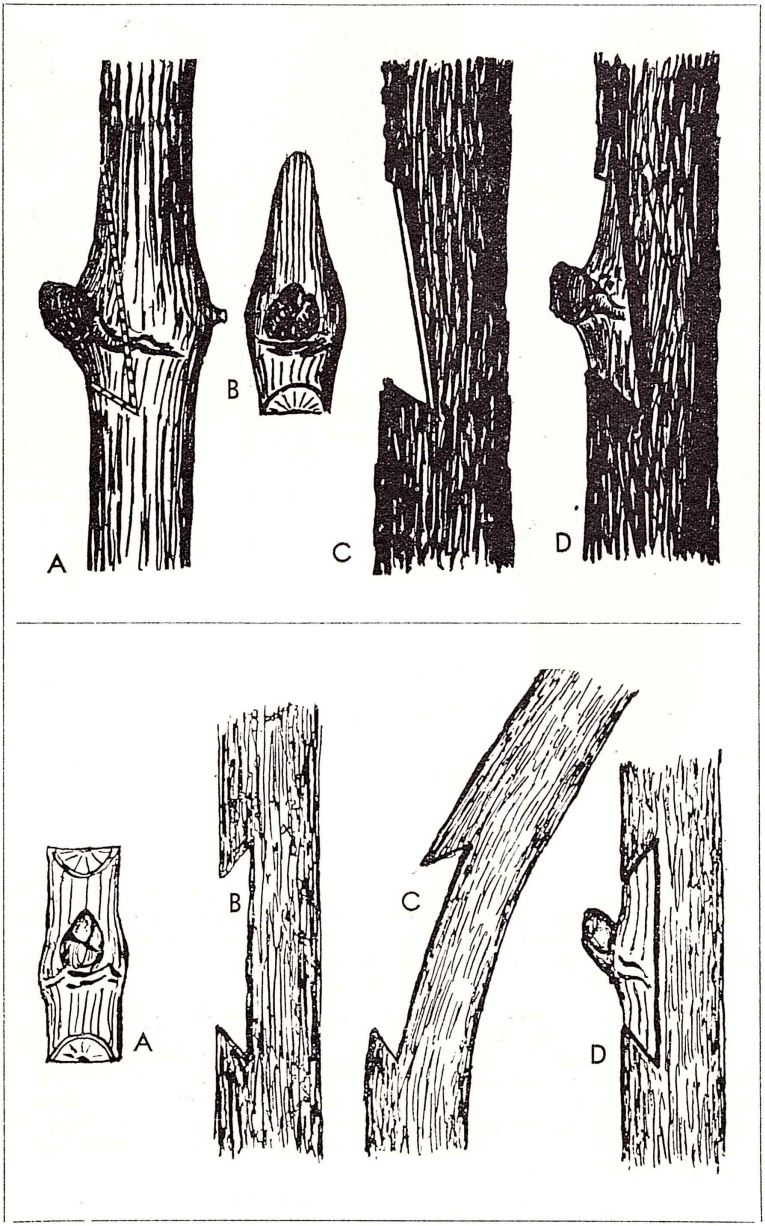
Vine cuttings planted in a furrow, which is later filled in. →



▲ Cleft graft with one bud on nursery stock.

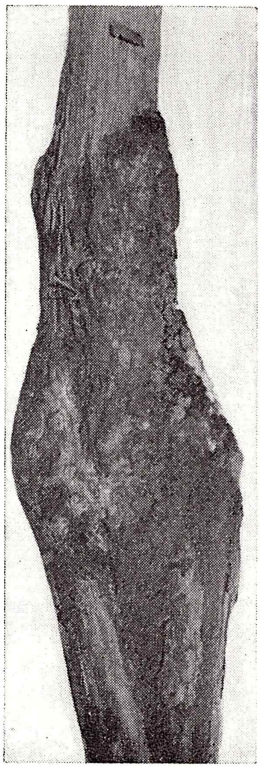
▲ Two views of cleft graft with two buds on larger stock.

▲ Cleft graft with two scions; an old vine re-grafted.

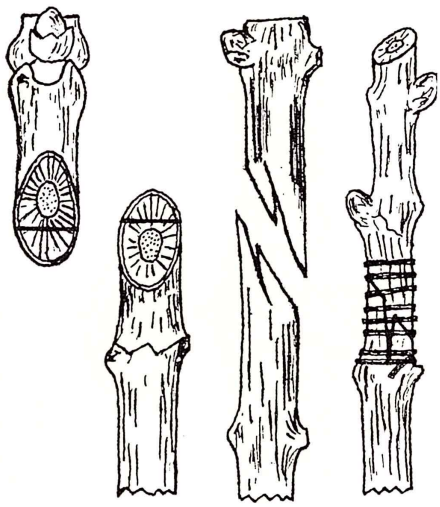


[*After Victorian Department of Agriculture Bulletin No. 35*

Two methods of performing the Spanish yema graft. Upper—A, B: Removal of bud. C: Stock prepared for bud. D: Completed graft ready for binding with raffia. Lower—A: Scion bud. B: Incision in stock. C: Stock bent at incision to facilitate insertion of scion. D: Completed graft ready for tying.



Close-up of well knitted cleft graft.
[*Sparrow*



Tongue graft.

up with the knife before it is withdrawn, to assist in joining. With matched wood and skilful performance the tongue-grafted joint is hardly visible. When this degree of perfection is not possible it is preferable for the points barely to reach than overlap. If there is any overlap, this portion should be cut off.

Binding of the grafted joints with raffia and mounding of the soil about 2 in. over the scion complete the operation. After serving to secure the scion in position until the joint has knitted, the raffia will rot away—a more durable material than raffia would have to be cut free. Grafting wax should not be used with vines, as it interferes with the callusing and knitting of the grafted joint in much the same way as a piece of adhesive plaster over a cut on the hand hinders healing by excluding air.

Grafting requires skill and careful attention to detail. It is most important to keep the grafting knife clean and with an almost razor edge while working. The cuts in the wedged scion for the cleft graft and in the diagonal surfaces for the tongue graft must be made with a single, quick motion of the knife. If the first cut is unsatisfactory, a new one should be made. Any attempt at paring the surface will result in irregularities and prevent the intimate contact necessary for a good union.

The percentage of successful unions achieved in nursery grafting depends considerably on the weather in October. Warm weather with a moderate amount of moisture in the soil is ideal for callusing, and under such conditions up to 95 percent of successful grafts is possible. If cold, wet weather occurs at the critical time, results may be as low as 50 percent. If the weather is excessively dry, water sprinklers should be used in moderation. Any weak vines or ones with defective unions should be culled out before planting.

Field Grafting

Sometimes the stock is established directly in position in the vineyard and most of it grafted the next season, but any stock which has made only weak growth is allowed two growing seasons before it is grafted. Grafting procedure is either identical to that already described or performed by budding. Field grafting by any method usually is not as satisfactory as nursery grafting.

Budding

A style of budding called the yema graft is used to some extent overseas for field grafting. This technique of grafting was evolved in Spain, yema being the Spanish word for bud. The appropriate time to do the yema graft is February, when vines are in foliage and buds on the current season's wood are properly ripened. One-year-old nursery-raised stock vines are planted out in the vineyard and grafted during the second growing season. The graft is made, as illustrated on page 23, at ground level.

After the bud has been inserted the soil is mounded well above the union. The growth of the stock is not checked in any way at this stage. Toward the end of winter the mound is removed and the stock decapitated about 5 in. above the graft, leaving a stub which is not removed until the following year. If the stock were cut back immediately, it would be liable to die back behind the grafted bud. Any failures may be cleft grafted the following September or October. A successful yema graft results in a complete and permanent bond between stock and scion (see page 23).

Green Grafting

Green grafting may be used for grafting in the nursery or in the vineyard and is superior to all other grafting methods in the success achieved in fusing stock and scion.

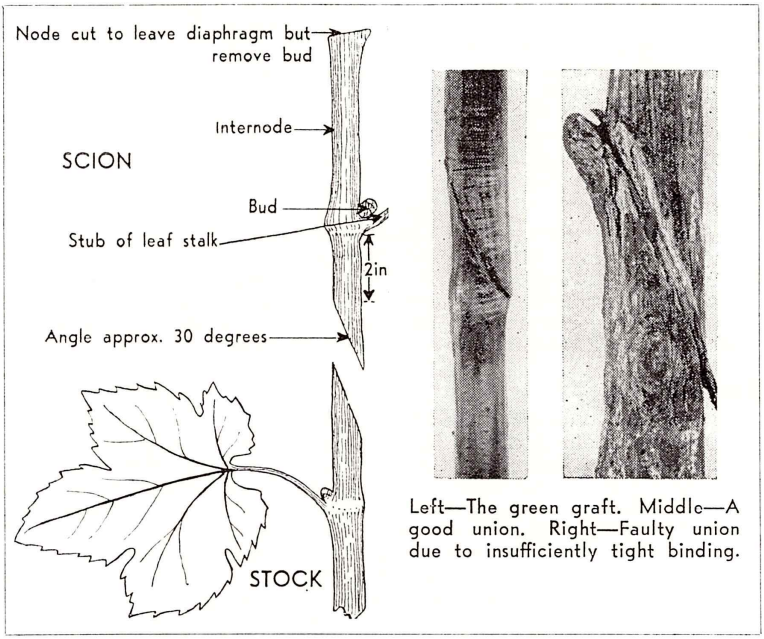
The most suitable time to do green grafting is in late November-early December or when the vines are flowering. The technique is relatively simple and excellent results (95 to 100 percent perfect unions) may be secured.

The knife used should have a razor edge and be perfectly clean. In hot weather it is desirable to graft in the early morning or evening, but time of day is of no consequence in dull weather. When old-established vines are being grafted over to another variety a shoot from a spur near the trunk or a water shoot in a similar position should be selected. Cropping may be continued as vines are being worked over, so there is no loss of production.

The green shoots to be used as scions are gathered as required and kept fresh in a piece of damp cloth. The prepared scion appears as illustrated on page 26.

The leaves are cut off the scions, but not the stocks, though any sublaterals are broken out of the latter. The angle and size of the stock and scion surfaces to be united should correspond.

Special thin rubber ribbon $\frac{3}{16}$ in. wide and very resilient is used for the binding, which is begun $\frac{1}{2}$ in. below the cut on the stock with a half



Left—The green graft. Middle—A good union. Right—Faulty union due to insufficiently tight binding.

hitch and continued to ½ in. above the union, where it is secured with another half hitch. The coils of the binding should overlap slightly to prevent drying out of the join. A cigarette paper is wrapped round the binding and gummed in place to protect it from the sun, or a vine leaf may be tied round it. The sap oozes from the top of the scion 2 to 3 hours after the operation is completed, and if the scion does not shrivel after 3 or 4 days, a satisfactory union is assured. The binding should be taken off 2 months later. The shoots growing from the scions should be attached to supports to safeguard them from the effects of strong winds.

Woollen thread is also sometimes used for binding the graft and seems to serve the purpose quite well, but the special rubber is better, because of its greater elasticity and because it holds its tension better.

As the graft is performed above ground level, there is no trouble with scion roots. With grafts done at ground level, severing of scion roots must be done continually. These roots if allowed to develop would short-circuit the stock roots, causing the latter to die eventually.

Top Grafting Established Vines

Unsuitable grape varieties may be converted readily to something better by a top grafting technique developed in New Zealand. After they have been reworked the vines are usually in full production the following season.

A cleft graft is performed on the vine trunk about 6 in. below the bottom wire.

Depending on the size of the trunk one or two scions, of two buds each, are inserted.

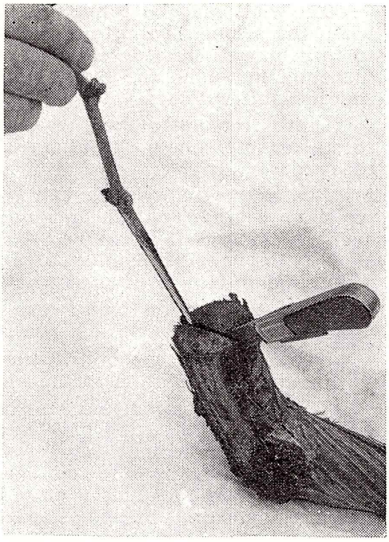
The inner bark or cambium layers of stock and scion should be carefully matched and the graft firmly and completely bound with insulating tape so that no cut surfaces are exposed.

The most favourable period for this grafting is from mid September to mid October. If the weather is cold and wet in September, delay grafting until October. Cold weather retards callus formation. Successful grafts have been obtained as late as the third week in November.

The success of the method lies in binding the graft with black adhesive insulating tape, commonly used in electrical work. Other materials such as raffia, cotton tape, and rubber and plastic substances with and without grafting wax were found inferior to insulating tape $\frac{3}{4}$ in. wide.

A sharp thin-bladed draw knife is a good tool for making the grafting incision or cleft in the vine trunk. It may be pressed into the wood with a rocking motion or tapped in with a mallet.

If the grain of the trunk is very twisted, it is better to make the cleft with a thin saw.

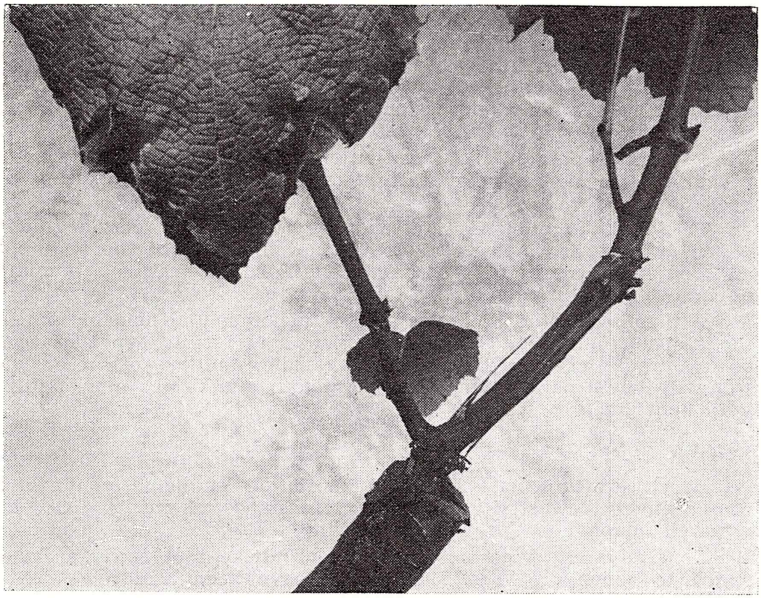


[*Sparrow*

▲ Performing the cleft graft. The cleft is made parallel to the direction in which the trellis runs, and the bottom bud of the scion points outward.

▼ Close-up of a single scion graft as it appeared in the autumn after grafting.

[*Sparrow*



The cleft may be conveniently prised open with a knife or chisel when the scion is being inserted. Two points should be observed here to form a well-shaped vine. The cleft should be made parallel to the direction in which the trellis runs, and the bottom bud of the scion should point outward.

Quite frequently the first shoot from the graft dies back, but a second shoot from a subsidiary bud takes its place if the union has callused.

Grafting wax is no advantage over the bound union when the stock wood is fairly thick and the sap plentiful. With thin stock wood, such as a cane formed the previous season, it is advantageous to smear the bound union with a wax which is a petrolatum-based compound having the consistency of thick grease.

Keep the cutting tools clean by wiping them frequently with a moist cloth.

The tape binding the graft should be cut and loosened in December to prevent strangulation at the union.

The scion wood should be taken from the vines in July or early August, cut into lengths of about 2 ft, and tied in bundles for easy handling. A convenient way of storing these cuttings until they are required for grafting is to stand them upright in a tub containing about 4 in. of water in a cool, dark place in a building or shed. The water will need replenishing during storage. The general method of storing cuttings is to stack them on the shaded south side of a building or hedge and cover them well with sand. If the buds have begun to move slightly when grafted, this is no serious disadvantage.

Wood for grafting should be quite moist when cut; if it is not, it should be soaked in water for 2 days.

Bench Grafting

Late last century when the depredation of the vine pest phylloxera threatened the existence of the European vineyards bench grafting of grape vines was evolved to meet the tremendous demand for grafted vines.

For speed and efficiency bench grafting is superior to other methods. Bench grafting on a well-organised system can achieve a daily output of about 1,000 grafts per operator, a performance which could not be remotely approached by other grafting techniques. The final percentage of successful grafts is usually about 95.

Manually operated and semi-automatic motorised machines are procurable for making the grafting cuts and further expediting the operations.

The high production rate and efficient results obtained with bench grafting are made possible by the simplicity of the technique and the maintenance of controlled conditions of heat and humidity during callus formation.

With other methods of grafting conducted in the field or nursery the grafting operation is less convenient and results depend largely on favourable weather. Dry weather retarding the flow of sap or cold, wet weather is harmful to callus formation and causes most failures with field grafting.

Suitable Stocks

Bench grafting has the main limitation of being confined to comparatively few stocks for high performance, as many stocks are not well adapted to this way of grafting.

Generally only vigorous stocks which strike root easily are well suited to bench grafting. Best results have been achieved in New

[*Sparrow*

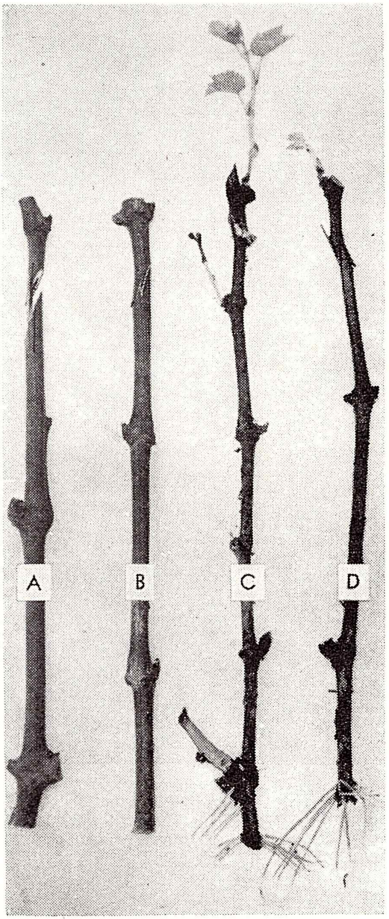
Box of grafts from callusing room. Some moss has been unpacked to show the grafts. A nurseryman points to strongly callused graft unions.

Zealand with *Mourvedre* × *Rupestris* 1202 stock and good results have also been reported with *Baco* No. 1. *Aramon* × *Rupestris Ganzin* No. 1 (A.R.G. 1) has been favourably reported on in overseas literature for bench grafting, but this stock has not been tested in New Zealand. *Cordifolia* and *Berlandieri* stocks have proved unsuitable and only comparatively poor results have been achieved with *Riparia* × *Rupestris* 3306, 3309, and 101-14.

Stock Cuttings

The stock cuttings should be taken from the vines about mid July, cut into lengths of about 15 in., and tied in bundles of 50 for convenient handling. Of the various methods tried for storing the stock cuttings until required for grafting, the following has proved most satisfactory.

A well-drained soil in a sunny position is selected. The bundles of cuttings are then half buried in an upright position by puddling them into holes which have been soaked with water. Puddling the soil and moving the bundles up and down when burying them permits the soil to penetrate between the cuttings, thereby excluding air and preventing deterioration from mould development.



Bench grafting sequence. A—Prepared stock and scion wood. B—Stock and scion jointed by whip or tongue graft. C—Untrimmed graft after callusing. D—Trimmed graft ready for planting.
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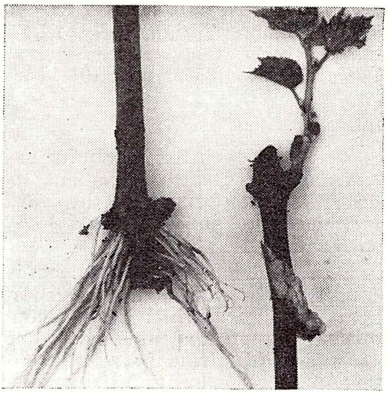

Sections of a typical bench grafted vine, showing the profuse callus formation and strong roots and shoot development after 3 weeks in callusing room.
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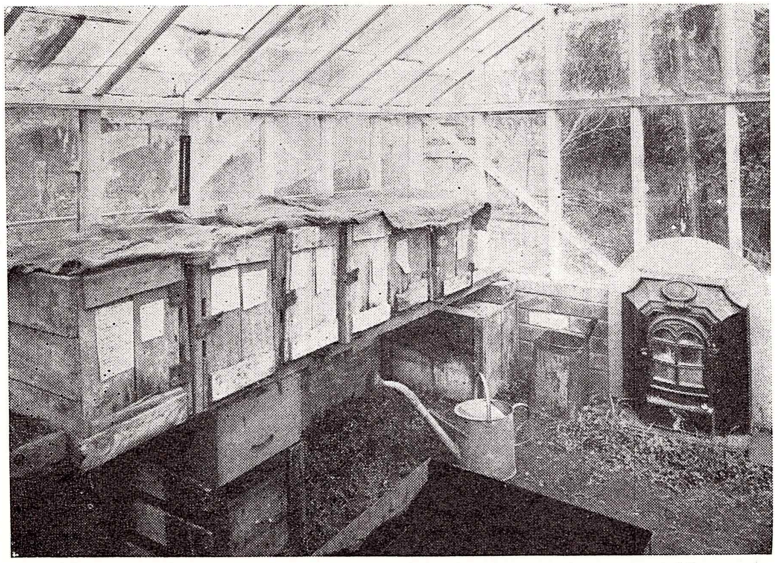


[*Sparrow*

Glasshouse adapted for callusing bench grafts, showing heating arrangement, boxes of grafts, and water tank in which boxes are immersed (foreground).

It has been found advantageous to leave the scion wood on the mother vines until late August where practicable. The scion cuttings are pruned to lengths of about 2 ft, tied into bundles, labelled, and stored in a cool, shaded position on the south side of a building or hedge and covered with sand.

The labels used for identification of the scion wood should be made of durable material, as cardboard labels tend to disintegrate in a sand bed. Careful attention to the storing of stock and scion wood is essential, as wood which has dried out to any extent before grafting will give poor results. If the scion wood has dried somewhat and there appears insufficient sap when the wood is dissected, it is advisable to cut it into pieces of one bud and soak it in water overnight before grafting.

Grafting

The grafting operation is best conducted not earlier than the second to third week in September to obviate the retarding effect of a cold nursery soil when the grafts are planted. When the stock wood is lifted for grafting some of the buds have usually begun to grow, but this is in no way detrimental to results.

Bench grafting may be conducted indoors if the weather is unpleasant or outdoors if conditions are suitable. The work is greatly simplified if stock and scion wood are previously sorted into corresponding sizes and placed in bins in a position close to the grafting operator, who works seated behind a bench or table.

Stock and scion are joined by the well-known tongue or whip graft. Provided the wood is reasonably well matched for size and the graft fits securely, minor imperfections are of little account. It is, however, preferable to have a slight overlap at the side points than an exposed area, which may occur if the cut surfaces are of unequal

[*Sparrow*

Planting out bench grafted vines in a nursery.

angles or the incision to form the tongue is insufficiently deep. A and B in the illustration on page 30 show the joining of stock and scion by the tongue graft. A well-made tongue graft holds the graft firmly enough without it being tied. Tying is actually detrimental, as it interferes with callus formation.

If there is a scarcity of scion wood, successful grafts can be made with very thin, spindly wood useless for other grafting methods. With such wood a cleft graft is used, the bark or cambium layers of stock and scion on one side being matched, and the union bound with raffia.

Preparing Boxes of Grafts

Completed grafts are carefully packed into boxes lined with 2 in. to 3 in. of green sphagnum moss and transferred to the callusing house.

The sides of the box are slatted to permit ventilation and one is hinged with strips of leather. With the side open the three interior walls of the box are lined with moss and the grafts packed in an upright position. When the box has been packed almost to capacity the open side is also provided with a layer of moss, the movable side is closed, and the tops of the grafts are covered with a light sprinkling of moss.

It is most important that the tops of the grafts be at the same level, otherwise the buds on the lower ones tend to rot. Small slats of wood among the grafts will improve ventilation, and aid callus formation and reduce deterioration by rot organisms, which can become troublesome under high temperature and humidity if ventilation in the callusing house is inadequate.

Callusing Grafts

A small glasshouse which has been adapted for callusing bench grafts is shown in the illustration on page 31. In the foreground is a shallow tank in which the boxes of prepared grafts are immersed before being placed in position on the bench at left. Sacking has been laid on top of the boxes to help maintain humidity and for easy observation of the contents. Humidity in the boxes has to be maintained almost at saturation point.

A watering-can with a fine rose, or a hose, is used to sprinkle the boxes with water at regular intervals. Frequency of damping down the house and boxes of grafts is usually a matter of judgment, but generally this must be done once daily. The condition of the moss on top of the grafts is a useful guide to moisture requirements; it should be neither wet nor dry but just damp. It is advisable to dip the boxes of grafts in water once a week, immersing them only about half way to avoid wetting the graft unions.

Temperature and Humidity

A hygrometer or wet and dry bulb thermometer is useful for indicating the humidity and watering requirements, and a thermometer is essential.

In the background of the illustration of the small glasshouse is a small domestic type of coke or coal heater. By regulating firing and adjustment of the damper it is possible to maintain the heat in the house conveniently within the required temperature limits for callusing of 75 to 80 degrees F. The provision of a thermostatically controlled electric heating unit instead of a fuel heater simplifies temperature control.

Possibly the optimum temperature is about 80 degrees F, but maintenance of an exact temperature is not critical and good results are assured if the grafts are held between 75 and 80 degrees. Higher

temperatures are undesirable because they increase the activity of spoilage organisms; lower temperatures retard the development of the grafts.

Some authorities consider that high callusing temperatures have an ultimate weakening effect on the grafted vine.

Glass construction is not essential for the callusing house and many are built of various other materials incorporating an insulating lining to reduce heat loss. A glasshouse has good lighting, takes advantage of solar heat, and can be put to other uses when not wanted for callusing vine grafts. In hot weather the natural temperature in a glasshouse can be excessive unless the ventilators are used, and much of the time artificial heat is required only at night.

The period required for callusing the grafts varies from 18 to 21 days. The grafts are then transferred to a nursery and planted out in the vineyard in the following season.

The remarkable callus formation, profuse stock roots, and vigorous scion shoot which have developed from a typical bench graft when taken out of the callusing house after 3 weeks are shown in the lower illustration on page 30. The method of storing the stock described earlier seems to account for this exceptional root development.

Treatment after Callusing

From the callusing room the boxes of grafts are taken directly out to the nursery. Any shoots on the stock are rubbed off by hand and the shoot on the scion is pinched back to one leaf before planting. Only the roots at the base node are left on the stock. C and D in the illustration on page 30 show the appearance of untrimmed and trimmed grafts respectively.

A fertile, friable, and well-drained soil is essential for a vine nursery, particularly for bench grafts which have started to grow and require good conditions to avert any setback. Before planting, the soil should contain adequate moisture, and watering by sprinkler should be carried out if necessary.

Planting out of bench grafted vines is shown in the illustration on page 32. The vines are spaced about 6 in. apart in trenched rows. When the trenches are partly filled the soil is pressed gently but firmly round the bases of the grafts, from which the roots emanate. Consolidation of the moist soil round the base roots is important. The final mounding up must be done carefully to avoid injury to the delicate shoots and the last of the soil should be placed in position by hand. In addition to weeding and spraying the nursery vines it is important to trim off any scion roots which may form. This is usually done in December.

To obtain stronger and even more precocious vines by bench grafting, 1-year-old rooted stock may be used instead of cuttings. With rooted stock it is necessary to prune the roots severely before grafting.

TRELLISING VINES

The object of trellising and pruning a grapevine is to make it conform to a shape designed to promote fruiting and to facilitate cultivation, spraying, harvesting, and other vineyard operations. The grape vine is a climbing plant in the same botanical classification as the Virginia creeper. In its natural state it grows in a confused manner, spreading along the ground, climbing and festooning surrounding vegetation, and producing only a small crop of inferior fruit. By scientific pruning, training, manuring, cultivation, spraying, selection of varieties, and other attention the vine may be induced to bear abundant crops of high-quality fruit.

The three main systems of trellising grape vines are the low trellis, the arched pergola, and the complete overhead pergola.

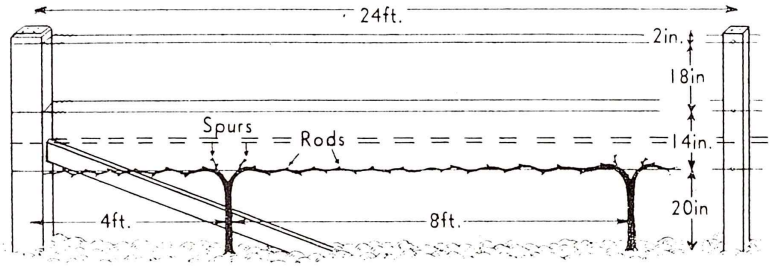
The Low Trellis

Mainly because it costs far less than the pergola type, the low trellis is in most general use in commercial vineyards. Reinforced-concrete strainers and intermediate posts are preferable to wood; the higher initial cost is compensated for eventually by much longer service, though care has to be taken to prevent damage by cultivating implements.

In the illustration on page 36 the strainer is 6 in. x 6 in. x 8 ft and reinforced with four $\frac{3}{8}$ in. rods; 3 ft 6 in. of the strainer is in the ground. The dimensions of the stay, which is reinforced by two $\frac{3}{8}$ in. rods, are 4 in. x $3\frac{1}{2}$ in. x 8 ft. The recess to take the stay is moulded with the post. The foot of the stay is 1 ft below ground to obviate any chance of its fouling implements and to reach more compacted soil.

[*Sparrow*

Wine grapes growing on a low trellis.



A style of low trellising. The dotted lines indicate the position of the extra double wires.

The intermediate posts are 4 in. x 4 in. x 6 ft 6 in. and reinforced with two ¼ in. rods. These posts are 2 ft in the ground. Posts in the trellis are 24 ft apart, and in the space three vines are accommodated at 8 ft intervals.

The first wire (No. 8 gauge) is 20 in. from the ground. By training the vine fairly high from the ground, cultivation under the trellis is simplified and air circulation, which discourages fungous diseases, is improved. The first wire carries the fruiting wood and so most of the weight. Above this it is usual to have two pairs of parallel No. 10 gauge wires 34 in. and 52 in. respectively from the ground. These wires are tied round the strainer post and fastened to the intermediate posts by tie wires through holes in the posts.

It is desirable to have another set of double wires between the first wire carrying the fruiting wood and the first double wires shown above. This greatly helps in training the growth in the very early stages.

The vines in the diagram above are as they would appear after being pruned on the double-guyot system. They carry two spurs and two 4 ft rods to each vine. The growth from these is trained between the two sets of wires above, which minimises tying of the laterals, a much more laborious task where only single wires are employed.

Where tractor cultivation is done, the minimum distance between trellises should be 9 ft.

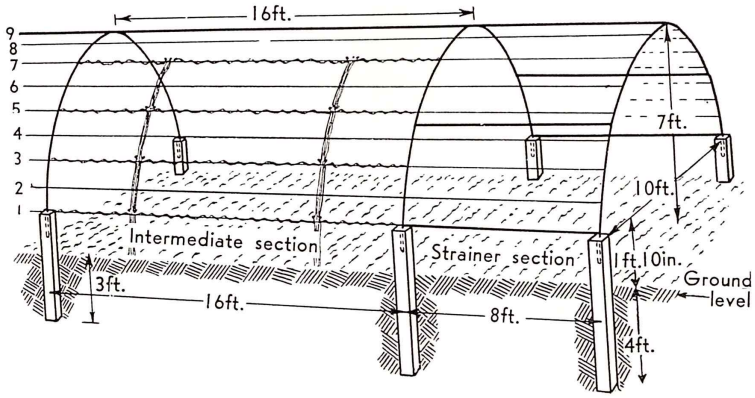
Arched Pergola

Both the arched pergola and the complete overhead pergola give a higher crop return for a given area than does a low trellis, but are suitable only for vigorous vine varieties in fertile soil and under ample rainfall. For a beginner in commercial grape growing with limited capital the less costly low trellis is advised.

The arched-pergola style of trellis is costly to erect if it is to be satisfactory, as it should be strong and permanent. The heavy weight of the crop and wind pressure will cause a flimsy structure to sag and collapse and will result in costly failure. For preference the pergola should run north and south.

In many instances vigorous varieties of vines trained on the pergola system have produced crops more than double those from similar vines trained on low trellises, so the high initial cost of pergolas will be justified eventually by crop returns.

The posts in the arched pergola illustrated on page 37 are of reinforced concrete 6 in. square, with a 1 ft length of 1½ in. galvanised pipe let in to each to form a socket to hold the pipe arches. The arches and connecting pipes on the strainer ends and intermediate sections



Details of an arched pergola.

are all $1\frac{1}{4}$ in. galvanised pipe. On the ends of the arches, $\frac{1}{3}\frac{1}{2}$ in. has to be turned off for 8 in. in a lathe so that the ends fit into the pipe sockets in the posts. The pipes are joined by special couplings and are not cut and threaded to fit the usual type of unions, which would impair strength. The perimeter of the arches is 16 ft and all the wires are No. 8 gauge and are 1 ft apart.

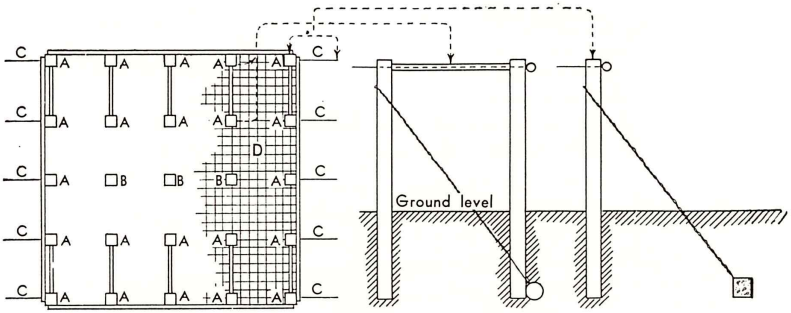
Before taking delivery of pipes it is advisable to have them bent, drilled for the wires, and turned off at the ends in a lathe at an engineering shop. The cost of construction of the trellis could be reduced by increasing the intervals between the intermediate sections and raising the height to allow for sag and to give head-room, though additional height would make pruning, picking, and other operations more difficult. Rigidity is given by a pipe (9) which runs along the top of the pergola the full length of it, uniting the strainer sections on either end with the intermediate sections.

The vine is trained so that a permanent arm reaches to within 2 ft of the top of the trellis and from the arm fruiting rods proceed laterally at intervals of 2 ft along wires 1, 3, 5, and 7. Wires 2, 4, 6, and 8 are the supports to which lateral growth from the fruiting rods is tied. All wires are No. 8 gauge, as wire of a lighter gauge would sag more. For every fruiting rod a spur of two buds is provided for replacing the rod the following year; so each vine has eight rods and eight spurs.

An arched pergola similar to that described would enhance the appearance of the drive-way of a home.

Complete Overhead Pergola

In a complete overhead pergola the posts are spaced on 10 ft squares and the lines of posts incorporating connecting pipes and stay wires on the perimeter of the system act as strainers on to which the overhead wires are strained. The strainer posts are 5 in. square and reinforced with four $\frac{1}{4}$ in. rods, and other posts are 4 in. square and reinforced with single $\frac{3}{8}$ in. rods down the centre (see page 38).



Left—Plan of an overhead trellis. Right—Side view of the strainers. A vine is trained up each post to form a permanent arm to the top of the trellis, and the fruiting rods radiate from this point. A indicates the strainer posts and B the intermediate posts, of which only few are shown in the diagram, as it is very condensed. The stay wires (C) on two sides of the trellis are anchored to heavy concrete blocks as shown in the side view. On the other two sides a different method of straining is used. The strain on the outer posts is shared by the next inner posts by means of pipe connections and stay wires anchored to 18in. x 4in. earthenware pipes filled with concrete which are placed against the bases of outer strainers. D is a section of the trellis showing the network of wires passing through the posts and tied to the pipes round the perimeter of the trellis.

Young vineyard, showing interim cropping of tomatoes. The tomatoes are supported by stakes tied to the wires which carry the vines.

All posts are 3 ft in the ground and the height above ground is 6 ft 6 in. The wires are all spaced 16 in. apart; those passing through the posts are No. 8 gauge and the remainder No. 10. In soft soil it is an advantage to place a 12 in. x 12 in. x 3 in. concrete foot at the base of each post to prevent it from sinking into the ground under the great weight of the fruit and foliage.

A vine is trained up each post to form a permanent arm to the top of the trellis, and the fruiting rods radiate from this point.

[*Sparrow*

A prolific crop of grapes on an arched pergola.

PRUNING

The objects of pruning are to attain and maintain suitable conformation of the vine and to enhance the quality and quantity of fruit produced. Vines should not be pruned before leaves have turned colour and are about to fall. Premature pruning has a weakening effect, but it is sometimes practised judiciously on late-ripening varieties to induce early bud burst the following season, with the consequent advantage of a longer ripening period. The converse also applies, late pruning delaying bud burst and being used in localities where spring frosts are likely.

The fruiting buds of the vine occur on the 1-year-old canes which grow from 2-year-old wood. Canes which arise from old wood are known as watershoots. These are not fruitful the year they appear, but sometimes can be used to adjust the shape of a vine or to renew an old, debilitated arm with extended spurs. Unless watershoots can be used thus, they are useless and should be rubbed off (disbudded) when they appear, as should other unnecessary growth.

Pruning should be done on a pattern designed to induce the vine to bear and properly mature as much as it can without being unduly

Pergola-trained vines in bearing.

[*Sparrow*

weakened. If the vine is weakened by over-cropping, insufficient strong and properly ripened fruiting wood will be made to enable the vine to carry a good crop the following season.

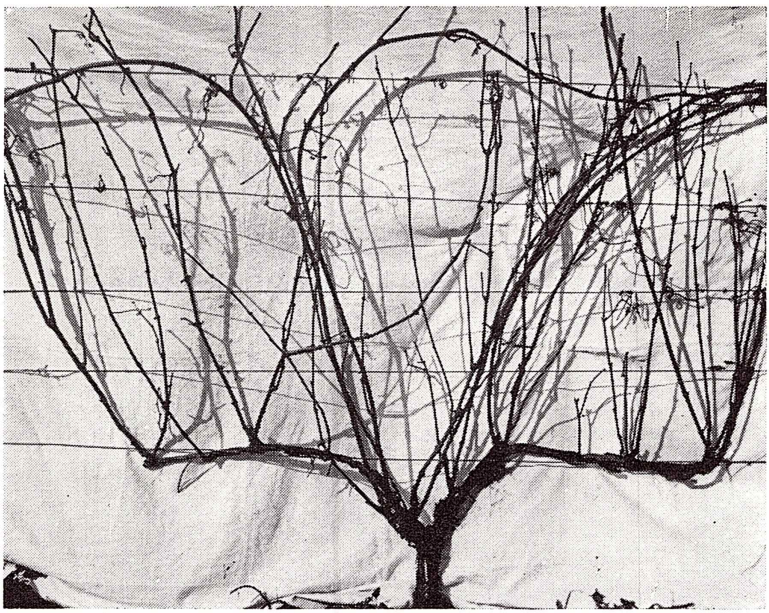
An efficient pruning formula has been used in the vineyards of New York State, whereby buds to produce 30 to 70 shoots per vine are retained by balanced pruning on a 30 + 10 formula for vines spaced 8 ft apart. This means that 30 fruiting buds or nodes are retained for the first pound of cane prunings, and 10 for each additional pound.

Spur and Long Pruning

There are several methods of pruning, but broadly all methods fall into one of two classes, short or long. In short or spur pruning, fruitful 1-year-old wood is reduced to two buds (see the top illustration on page 42), and in the second method long bearers known as canes or rods are left (see the two lower illustrations page 42).

When long bearers or rods are left a spur of two buds to each rod is always provided. The top bud of the spur furnishes the new rod and the bottom bud the new spur, the old rod being removed entirely at pruning. If growth from the bottom bud were used for the rod and that from the top for the spur, there would be unnecessary extension of the framework of the vine. Similarly, with spur pruning, growth from the top bud of the spur is removed and growth from the bottom bud reduced to two eyes to make a new spur.

Some vines are better if pruned long, because the most fruitful buds occur away from the bases of canes; other vines are pruned short because the fruitful buds are near the bases of canes. With others the fruiting propensity of the buds is fairly even along the cane, and long or short pruning is optional; sometimes such varieties are pruned "half



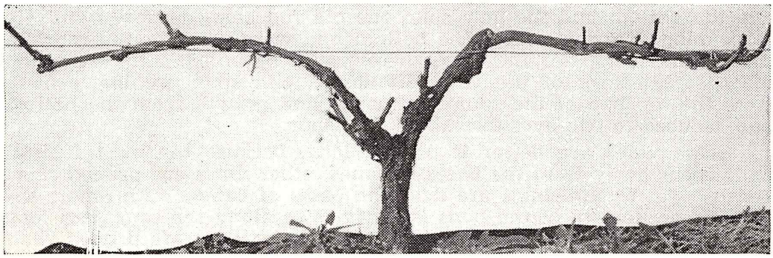
[*Sparrow*

An unpruned vine.

long", leaving four or five buds a spur instead of two. Two of the most common outdoor table grape varieties are Black Hamburgh and Albany Surprise; the former is pruned short (spur pruned) and the latter long (rod and spur pruned). If Albany Surprise were half-long pruned—and it seems to do fairly well on that method—the vine would appear similar to that shown in the top illustration below, but the spurs would extend further.

If a vine is too vigorous, it bears little fruit and makes a lot of foliage and wood. When such a vine is pruned, adequate fruiting wood should be left to give the vine scope for its vigour. If a vine is weak, the wood left at pruning should be reduced commensurate with its strength.

Under conditions which induce vigorous growth in vines the system of pruning to retain long bearers is most successful for nearly all varieties and in most of the viticultural areas of New Zealand. The art in pruning is to judge the vigour of the vine and to leave wood



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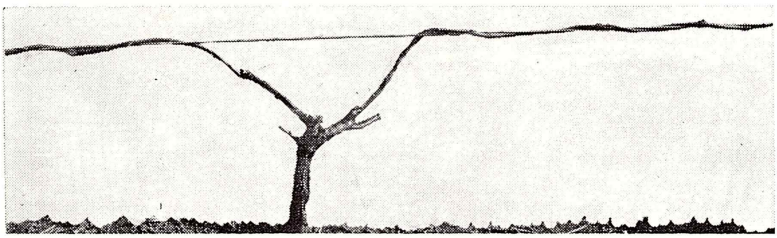
A vine spur pruned.



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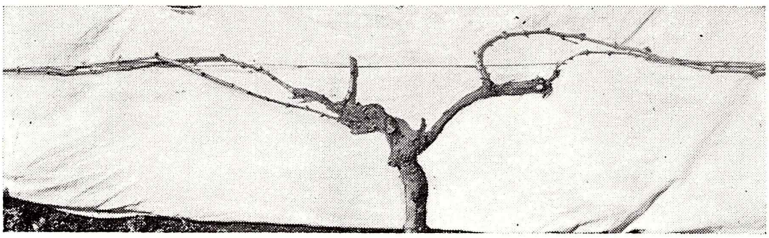
Long-pruned vine with two rods.



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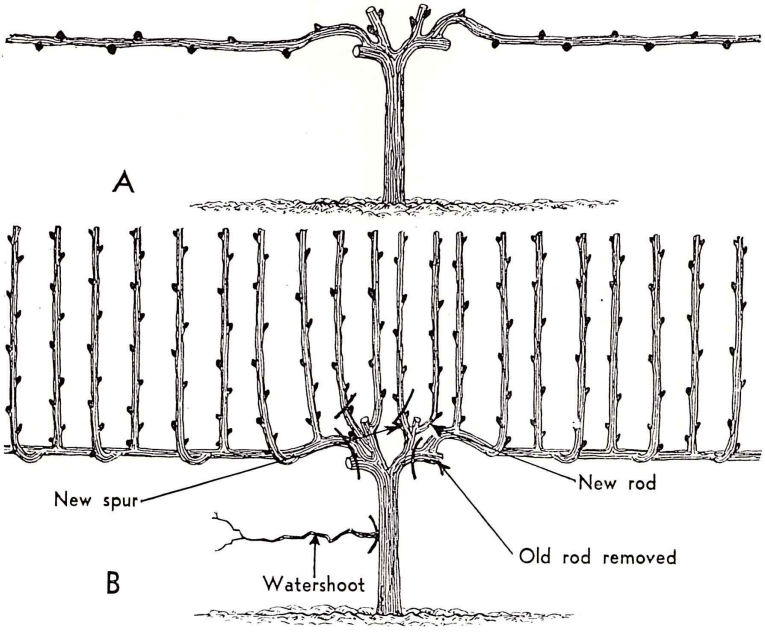
Long-pruned vine with four rods.



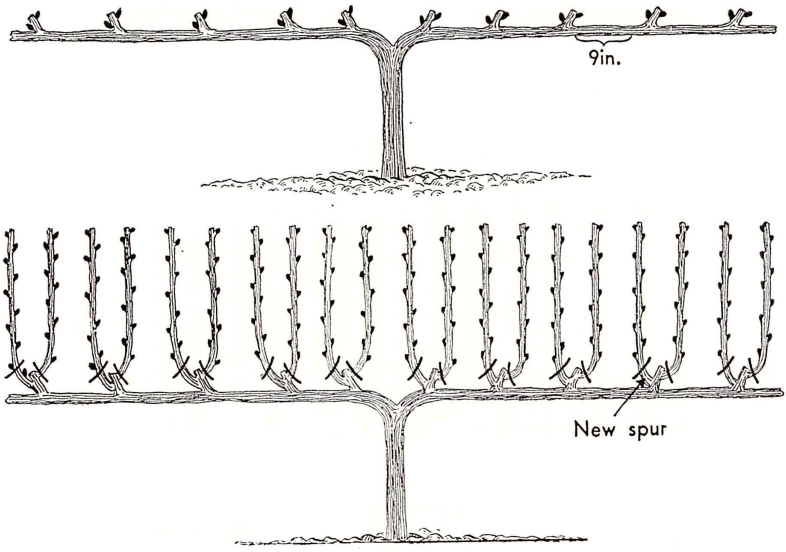
Vine long pruned (A) and the same vine the following season before being pruned (B).

accordingly. Undue suppression of a vigorous vine at pruning will be indicated by a profusion of watershoots and little fruit. On the other hand, if an excess of wood is left at pruning for a number of seasons, the vine will be progressively weakened, as evidenced by spindly growth. In such a case the correct procedure would be to prune more severely than previously.

The diagram above shows a vine long pruned (A) and the same vine (B) the following season before being pruned, with lines to indicate where the cuts are to be made. A vine is shown before pruning on page 41 and after pruning on page 42 (top illustration). In the case of a very vigorous vine trained as shown in the illustration above, two rods instead of one may be left on either side, an equal number of spurs being provided; in this instance four spurs would be required because of the four rods. For a vigorous vine trained according to the system shown in the upper illustration on page 42 the fruiting wood is increased by providing additional spurs, if extension is possible, or by incorporating a number of short bearers at intervals along the permanent arm, which means departing from the original system (see page 46).

Pruning and Training Shy-bearing Vines

Most high-quality wine grapes and a number of good table varieties are inclined to be poor bearers. Because of this failing many desirable varieties from a quality standpoint are not grown to any extent.



Spur pruning.

Most shy-bearing varieties are comparatively weak growers. Any system of training which encourages the formation of larger vines will increase vigour and cropping.

Weak-growing vines are commonly pruned too severely, which has a weakening effect, leading to serious debilitation. When vines are young it is important to limit the crop, as overcropping at this stage weakens their constitution in after years. Faulty nutrition and exposure to disease and insect damage may also cause stunting with long-term detrimental effects. No amount of attention to pruning and training can produce results if not supported by good, all-round vineyard husbandry.

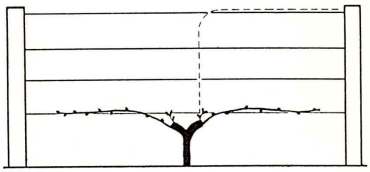
The mistake of excessive pruning becomes apparent when it is realised that root formation is directly related to foliage development. By restricting foliage development severe pruning thus inhibits root extension, just as though the roots themselves were pruned. To obtain vigorous, productive vines it is therefore necessary to adopt pruning and training methods which promote the necessary development.

A suitable system is shown on page 47. Applied to the Pinot varieties at Henderson, this system has more than doubled many crops.

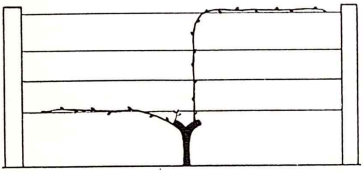
Vines may be converted to this new inverted cordon system of training in three seasons without loss of production.

The steps in conversion are shown in the diagrams on page 45. First, a strong cane arising near the trunk from a spur or watershoot is selected. This is laid down on the top wire of the trellis and only one bearing rod is left on the old system on the bottom wire. Growth from buds lower than the one immediately below the top wire is removed as superfluous on the newly trained cane. The bud just below the top wire later forms the other arm.

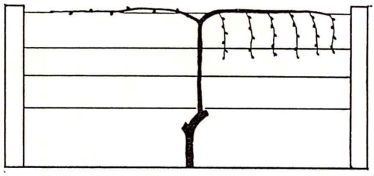
At the second pruning growth from the cane on the top wire is laid to form the other arm and a number of short inverted fruiting



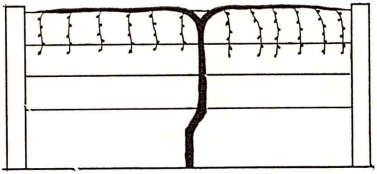
The dotted line indicates growth selected at next pruning to form new arm on top wire.



Pruning first year.



Pruning second year.



Pruning third year. Conversion completed.

Conversion to Inverted Cordon System

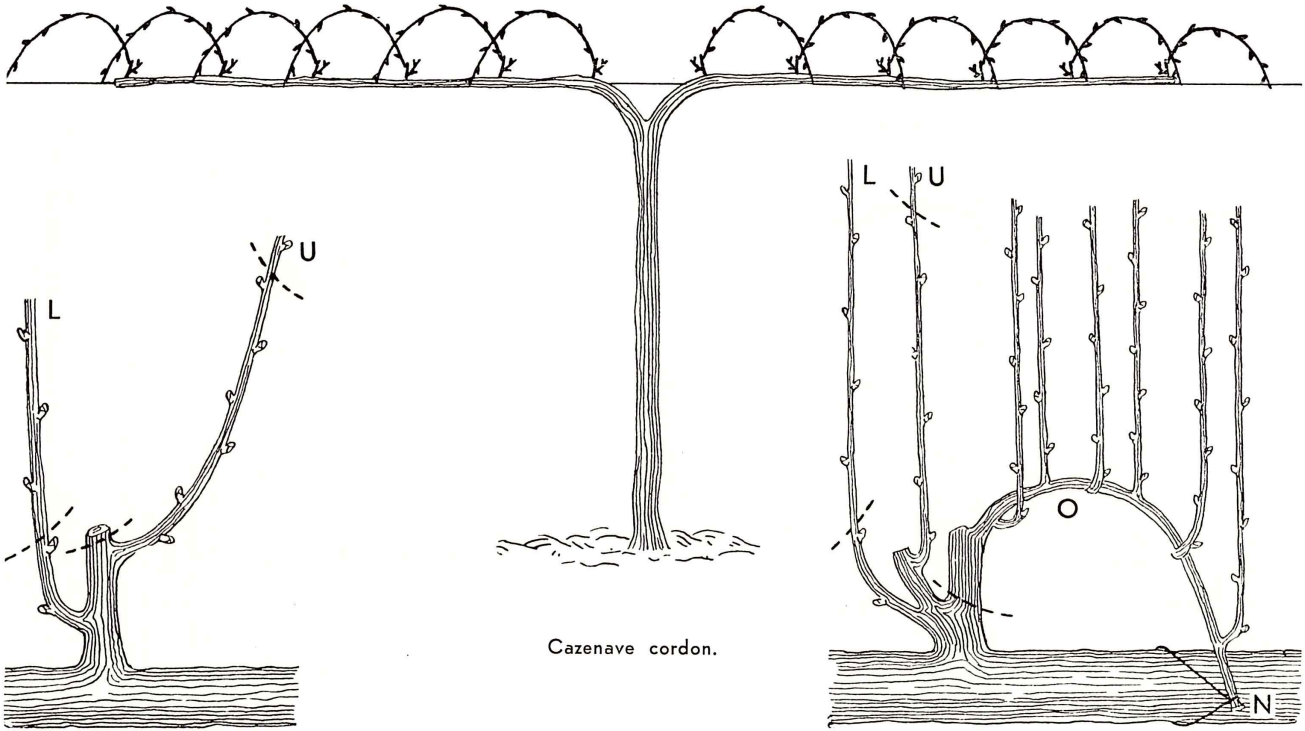
rods. At the same time all wood on the old system on the bottom wire is removed.

At the third pruning the short inverted fruit-bearing rods are carried the full length of the new permanent arms, completing the new framework. Routine pruning from here consists of renewing the short bearers each year from a basal shoot. Inversion of the bearers usually causes the basal shoots to break strongly, allowing their renewal close to the main arms without the necessity of providing a two-bud spur to each bearer for this purpose, as with other systems of long pruning. It is preferable to renew the main arms about every 5 years.

If bending the bearers down for tying is difficult, the work can be eased by bending them progressively at each internode with both hands, a start being made at the base.

Another system of training, which is commonly adopted with shy-bearing vines, is known as the casanave cordon. The vine is first established on the spur system, then at each spur a short bearer of six to eight buds is also formed. The short bearers are tied to the main horizontal arms and renewed annually from the spurs.

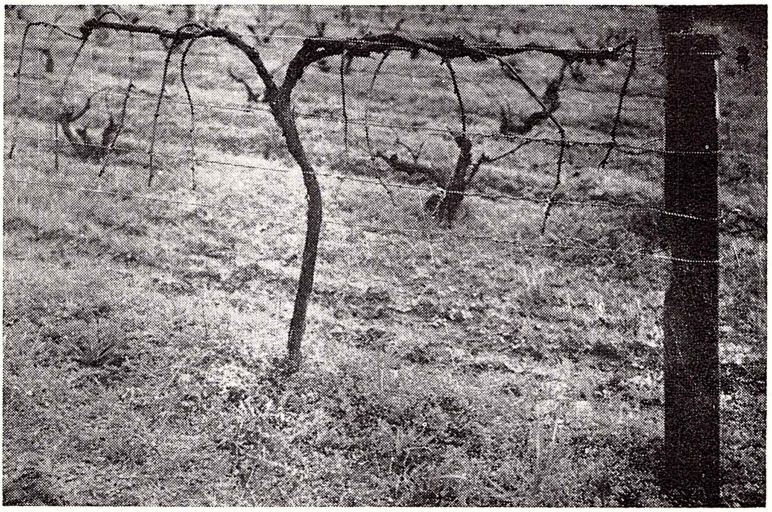
The formation of a cordon from a two-bud spur and the annual pruning of a cordon so formed are shown on page 46. The pruning cuts are shown by dotted lines. The bearers are usually cut back at a node to form a flange for more secure tying. If the vine appears over-taxed, the number of short bearers should be reduced to perhaps half, making a short bearer at every alternate spur.



Cazenave cordon.

▲ Formation of a cordon from growth made by a two-bud spur. Lower shoot (L) cut back to make a new spur. Upper shoot (U) shortened to form a small bearer.

Annual pruning of a cordon. ▲ Old bearer (O-N) removed. Upper shoot from spur (U) shortened to form new bearer. Lower shoot (L) cut back to make a new spur.



[*Sparrow*

Vine converted to inverted cordon system in a commercial vineyard.

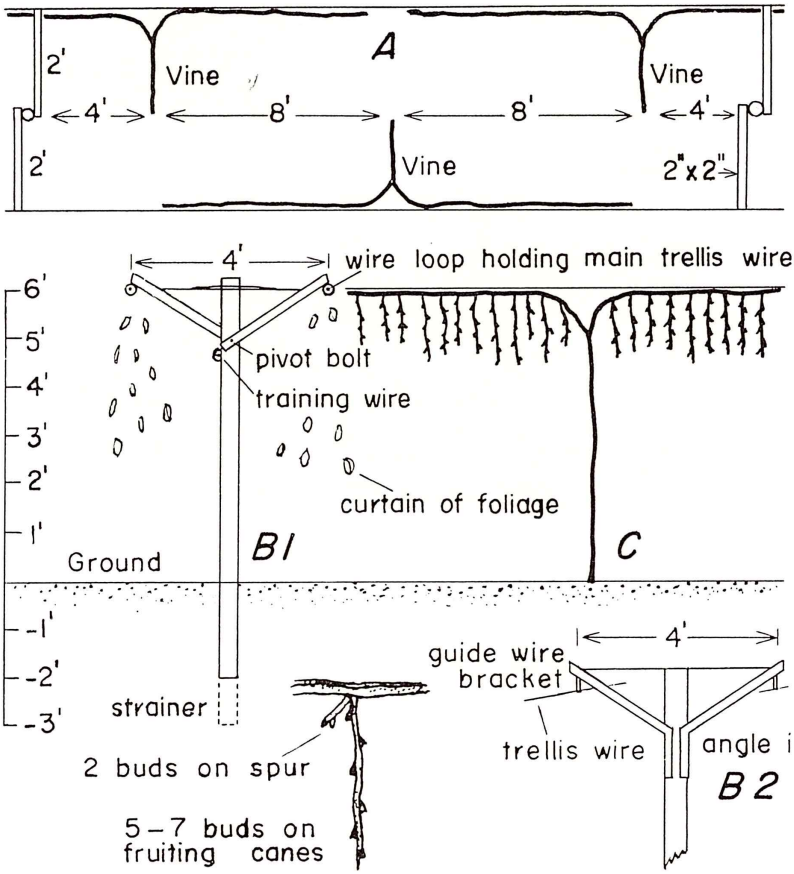
Geneva Double Curtain Training

A promising modification of the inverted cordon system described above was recently developed in the U.S.A. and is known as the Geneva Double Curtain (GDC) training. Under favourable conditions the GDC training has increased the grape yield by 40 percent for own-rooted vines and 90 percent for grafted vines. The key to the success of GDC training is that the vine is given adequate scope to develop and crop without unduly limiting the light intensity on the foliage. With most other training systems, an increase in crop follows the laying down of more fruiting wood at pruning, but maturity is delayed and the vines are weakened.

With the GDC training the vine supports a bigger crop with no adverse effects, because ample foliage well exposed to the light is provided.

The GDC trellis (see diagram page 48) consists of supporting posts spaced 24 ft apart. These posts are usually 8 ft long and are 6 ft above the ground. At a 4 ft 6 in. level a pivot bolt secures two wooden arms each 2 ft x 2 in. x 2 in. On the side of the post at the 4 ft 6 in. level a No. 12 gauge training wire is also secured. The top of each of the wooden arms is held in place by looped wire, which is folded half way around the top of the post and is brought together to pass through the upper end of the wooden arm. On the outer side of the arm this wire is twisted into a circle. These wire circles hold the No. 9 gauge wire running along the top of the trellis for training the arms of the vine along and thus support the weight of foliage and crop.

For the GDC trellis the vines are trained similarly to that described for the inverted cordon system, except that every alternate vine is trained on the opposite side of the T-head trellis to the intermediate vines. As the vines are planted 8 ft apart, this arrangement permits each vine 16 ft of cropping space.



Geneva Double Curtain Training

A—Diagrammatic overhead view of trellis showing vines placed 8 ft apart, each with 16 ft space for cropping.

B1—End view of trellis post showing 4 ft wide T arm formed by two 2 ft x 2 in. x 2 in. wooden arms held by pivot bolt at base and wire loops at top, permitting the arms to oscillate for mechanical harvesting.

B2—Alternative T arm arrangement. Arms of angle iron fixed to post. Main trellis wires carrying crop can oscillate in a guide wire bracket for mechanical harvesting.

C—A vine after pruning showing inverted cordon with a series of five- to eight-bud fruiting canes, each with a two-bud spur at base.

The outer wires on the T head of the trellis are 4 ft apart and are used to train the permanent arms along, thus supporting the foliage to give a double curtain appearance during the growing season.

Along the permanent arms of the vines are short fruiting canes of at least five buds spaced about 8 in. apart and at the base of each is a two-bud spur for making strong replacement wood for the following year's crop. In the U.S.A. the width between the rows is 9 ft. With protrusion of the trellis arms, this leaves an unobstructed inter-row space of only 5 ft. The suspended curtains of foliage are moved aside by a shielding on the tractor to allow passage of vineyard equipment. A width of 12 ft between the rows for the GDC system may be better for New Zealand conditions.

This system of training is best suited to vigorous growing vines. Weaker vines would be more suitable on strong rootstock. A mature vigorous vineyard can be readily converted to GDC training in one or two growing seasons.

This trellising system is adaptable to mechanical harvesting by a new machine only recently developed. With this machine the wine grapes are shaken off the curtains by an impacting device and are directed by shielding on to a conveyer which transfers them to a holding bin. The pivot bolt holding the T arms of the trellis permits the vine arms and suspended curtains of foliage to be vigorously shaken by the mechanical harvester.

An alternative T-arm arrangement may also be used. With this, the arms are of angle steel bolted to the posts to remain in a fixed position. A stay wire is stapled on top of the post and connects the T arms. This wire connection is formed into a vertical holding guide permitting the enclosed trellis wire carrying the crop to be shaken up and down without movement of the trellis posts and T arms.

Simple T arms could be made with 4 ft lengths of 4 in. x 2 in. timber. These may be firmly secured to wooden posts by mortising the top of the posts to fit the T arms and bolting together. In light soils exposed to strong winds, it would be advisable for strainers to be 3 ft 6 in. in the ground and intermediate posts 2 ft 6 in.

This mechanical harvester for wine grapes has not yet been adopted on a commercial scale in the U.S.A. No suitable economical mechanical harvester has been developed for table grapes.

The principle of extension to promote vitality may be taken a stage further to the pergola system of trellising.

The complete overhead pergola with which a post is used to each vine and cover of cross wires has been described.

The Veranda-type Pergola

The scheme is illustrated on pages 50 and 51. The vines are usually spaced 8 ft to 10 ft apart with a corresponding distance between the rows. Only one vine in every three is supported by a post.

During establishment the unsupported vines are staked until self-supporting. Alternatively the vines may be led up to the top of the trellis on strong twine stretched taut between the centre wire and a peg close to the vines. If the twine is treated with a preservative compound, it will last for a few years.

The whole structure must be very secure, as wind pressure will collapse anything flimsy and insecure in the ground.

Training the vines on this type of pergola is somewhat similar to that previously explained for the inverted cordon method. When the vine reaches the top of the trellis all lower shoots are kept disbudded. The sequence of pruning operations to establish vines on this system is shown in the diagram on page 51. The permanent framework of the

vine forms a T shape. Proceeding from the arms are the annually replaceable spurs of two buds and short bearers of about six buds. The spurs provide the replacement wood each year. The shoot proceeding from the lower bud of each spur is shortened back to two buds to form a new spur. The shoot from the upper bud of each spur is pruned to about six buds to form a new fruit bearer and the old bearer is entirely removed.

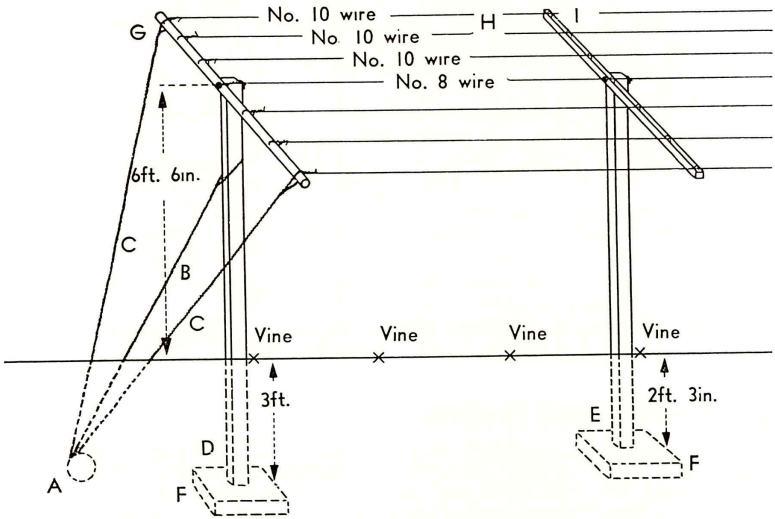
This arrangement prevents undue extension of the permanent framework. Without spurs it is difficult to replace the fruit bearers close to the main arm, as the basal shoots on the fruit bearers are generally too weak.

It is important to train the vine trunks as straight and perpendicular as possible, as they then afford better support and relieve the weight on the trellis.

Pergola systems are particularly well suited to table grapes, as the bunches hang freely beneath the trellis. This permits drying out of moisture and accessibility to sprays and dusts, thus simplifying disease control.

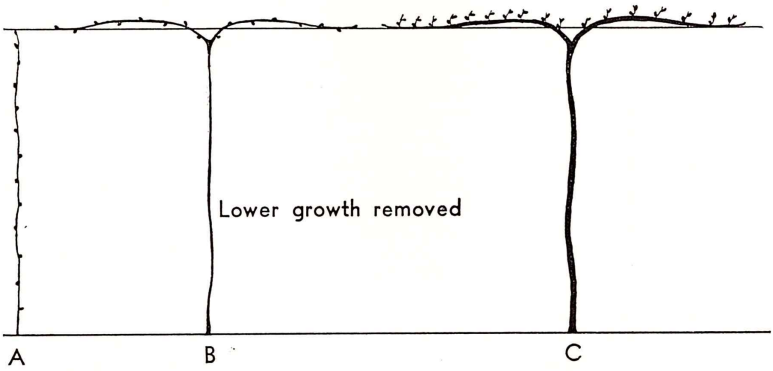
Weak vines trained on the principle of extension require to be grafted on to a strong stock, such as Chasselas x Berlandieri 41B, Mourvedre x Rupestris 1202, and Baco No. 1.

Structural Details of Veranda Pergola



A—Stay block set 2ft. to 3ft. in soil.
B—Main stay of four strands of No. 8 galvanised wire twisted tight.
C—Beam stays of two strands of No. 8 galvanised wire.
D.—End post of 4in. x 4in. treated timber or heavily reinforced concrete.
E—Intermediate posts of 4in. x 4in. treated timber or reinforced concrete.
F—Flat stone or 12in. square concrete slab for soft subsoils to prevent post sinking.
G—Main cross beam of 1¼in. galvanised piping 5ft. long and bolted at centre.
H—Wire spacing of 10in.
I—Intermediate cross beam of 4in. x 2in. timber 5ft. long and grooved and loosely stapled to hold wires.

Training Vines on to Veranda Pergola

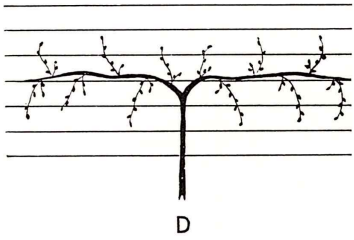


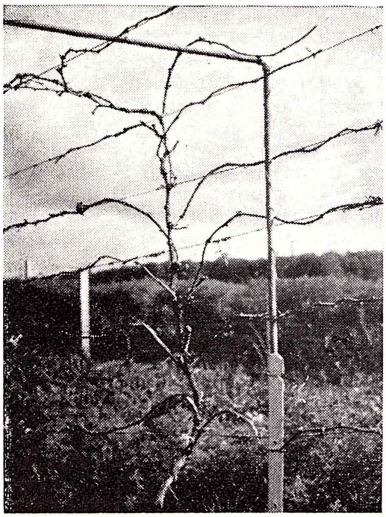
A—Pruning first year. Leader taken to top of trellis.

B—Pruning second year. Laterals laid down to form permanent arms from two top buds. All lower growth removed.

C—Pruning third year. Growth from arms cut back to two-bud spurs.

D—Pruning fourth year. Growth from top bud of each spur cut back to form short bearer and growth from lower bud cut back to two buds to form new spur. Henceforth new short bearers are laid down each year from the spurs, which are likewise renewed. Last year's bearing wood is entirely removed each season.





Method of pruning vines on arched pergola. Vines may be trained in this way on a wall.

Root Pruning

Pruning of vine roots should be done every 5 years. As vines age the feeder roots extend further from the vines and much of the feeding area becomes occupied with large (and sometimes dead) roots, which are not collecting nourishment; only the fine, hair roots on the subsidiary roots do this.

Deep ploughing on one side of the vines, which will sever the roots and result in the growth of a new, invigorated rooting system, is recommended. After 2 or 3 years the operation may be repeated on the other side of the vines.

GENERAL VINEYARD WORK

Cultivation

Cultivation of vineyards should never be deep, as such cultivation forces rooting systems to descend into the cold, damp subsoil, and a multitude of disorders follows—vines show deficiency symptoms, become weak, and fail to set and ripen the fruit properly. Conditions of warmth, air, and available nourishment essential to the active functioning and development of the roots are present only near the surface of the soil.

The usual method is to plough on to the vines in autumn to keep water away from the vines and leave land in this condition until early spring, when the soil is ploughed away from the vines and disced and harrowed or rotary hoed until level and in good tilth. During the growing period of the vine, cultivation is done mainly to suppress weed growth, and should only be shallow to serve this purpose. Ploughing is preferable to discing or rotary hoeing in autumn, because better surface drainage is obtained.

Cover crops are turned under in early spring. The rotary hoe is ideal for this purpose, as it chops the growth into small pieces and mixes it with the topsoil, thus ensuring quick decomposition.

A plough and an offset rotary hoe driven from the power take-off are an excellent combination for vineyard cultivation. When fitted with hydraulic controls these implements can be raised from the tractor very conveniently when the tractor is turned at the headlands. The offset rotary hoe can work very close to the vines, which reduces the difficulty of cultivating under the trellis; it is also more destructive to weed growth than other implements, the effect of most of which is to uproot weeds but to replant them. The rotary hoe can be set to chaff the weeds and leave them on the surface to dry and die. Prunings of ordinary dimensions may also be effectively chopped up with the rotary hoe and incorporated in the soil.

After a few runs with the rotary hoe during summer cultivation, prunings are mangled and cut to small fragments, which decompose readily in the soil.

Provided that vines have been kept free from fungous diseases, it is better to let the prunings contribute to building up the humus content of the soil than to collect and burn them as is often done.

The most efficient implement for mechanical weeding under the vine trellis is a manoeuvrable small grader blade attached to the side of the tractor. This blade can be quickly and conveniently operated by the tractor driver with the hydraulically controlled mechanism included with this implement. As the actions of the blade can be readily observed by the tractor driver it can be precisely guided with little risk of damaging the vines. Compared with most other implements designed for weeding under the vine trellis it has a further advantage as a labour-saving device in that an operator apart from the tractor driver is not required.

Weed Control with Herbicides

The use of certain herbicides for controlling weed growth under the vine trellis appears to be a satisfactory and more economic alternative to cultivation. An effective treatment has been with paraquat at 1 to 2 lb of active ingredient per acre for a quick "knock-down" of the weeds, followed about a week later with atrazine or simazine at 2 to 4 lb of active ingredient per acre. Atrazine on account of its greater solubility than simazine is not recommended for sandy soils. Three treatments during the season appear necessary in higher-rainfall areas: first in mid September, second in early November, and third in early April. The action of most herbicides

is intensified by the addition of a non-ionic wetting agent to the spray preparation. In lower-rainfall areas, where weeds are not profuse, satisfactory control may be obtained with paraquat alone.

For spraying under the vine trellis a strip 4 ft wide is ample and represents about ½ acre only for herbicide application in each acre of vineyard. For aid in standardising the rate of application, growers should note that 3,630 yd of a 4 ft strip is 1 acre.

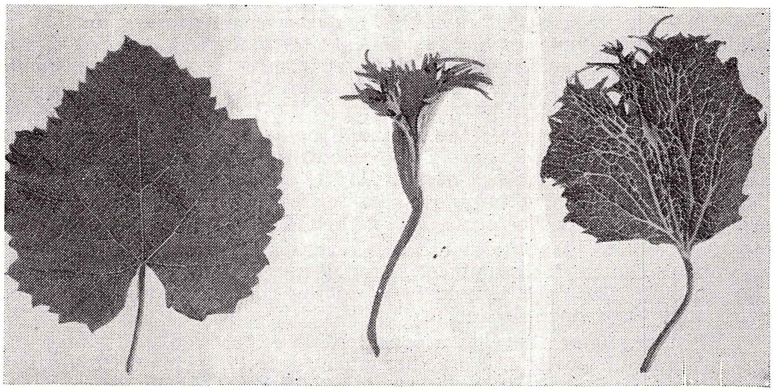
A more efficient weed control than using paraquat alone is obtained with a mixture of equal parts of paraquat and diquat. The inclusion of diquat provides better control of the broad-leafed weeds. This mixture is used at the rate of 2 pints per acre diluted with up to 100 gallons of water to which ½ pint of spreader is added. The cost of materials for spraying 4 ft strips under the trellises of an acre of vines is $2.65.

Hormone Spray Injury

The Agricultural Chemicals (Vineyard) Regulations 1962 were designed to help protect vineyards from the indiscriminate use of hormone weedkillers damaging to vines. It is against these regulations for anyone to use such hormonal preparations during the period 1 September to 30 April within 5 miles of vineyards if applied from aircraft and within 1 or 5 miles if applied from the ground, depending on how applied. These regulations also place certain restrictions on the use of some hormonal preparations near vineyards during the period 1 May to 31 August, when vines are dormant.

Grape vines are particularly susceptible to damage during the growing season from September to the end of April. Anyone wishing to use hormone weedkillers near vineyards should only consider doing so after notifying the Department of Agriculture and becoming familiar with the hazards and legal responsibilities involved.

Injury to grape vines from the hormone weedkiller 2,4-D (2,4-dichlorophenoxyacetic acid) has been reported from various parts of New Zealand. Grape vines are very susceptible to injury from 2,4-D, even in very minute amounts. Severe injury has occurred to vines which were ½ mile from where 2,4-D was applied to destroy weeds on a golf course. The minute quantity carried this distance by wind drift was sufficient almost to kill the vines. Symptoms of injury from this cause are distortion and stunting of the foliage. Wind-carried dust from hormone-treated superphosphate has also damaged vines.



[*L. H. Wright*

Grape leaves showing effect of 2,4-D, compared with healthy leaf on the left.

Frost Protection

Areas north of and including Auckland are normally free from late spring frosts. In most other localities where grapes are grown, including Gisborne, Hawke's Bay, and Nelson districts, late spring frosts occur periodically.

Frost is damaging to vines at any stage of growth when the temperature falls below 30 degrees F. To reduce losses from frost damage varieties should be planted which either bud late or have fruitful subsidiary buds, enabling them to produce a worth-while crop after frosting. Most of the Pinots bud late, while Frontignan, Cabernet Sauvignon, Semillon, Seibel 5409, Seibel 5437, and many other early productive hybrids have excellent powers of recovery after frosting. Shiraz and Rhine Riesling have only about 45 percent power of recovery.

In areas subject to late frosts the main spring cultivation should be done before bud burst, and the soil left undisturbed during September and October, the period of greatest frost risk. A weed-free, level, compact soil absorbs and holds more sun heat. High trellising significantly reduces frost damage.

Susceptible varieties can be protected from heavy frosts only by the use of oil-burning heaters.

About 30 efficient oil-burning heaters per acre are needed to protect a vineyard from heavy frosts.

In Germany a sprinkler irrigation system has been used successfully for many years to prevent frost damage in vineyards, and this system was recently adopted by some orchardists in Central Otago and has proved very satisfactory.

Low precipitation sprinklers prevent frost damage through the latent heat released from the applied water when it freezes. Provided the sprinkling is continuous during frost periods, the temperature of the plants being sprinkled does not fall more than about 1 degree F below the freezing point of water, and thus remains above the critical temperature of 30 degrees F.

Cincturing

Cincturing of vines may serve two purposes. Performed at flowering, it can improve the setting of many varieties.

Performed 3 weeks after flowering cincturing increases berry size and advances ripening by about a week and hence is valuable for table grapes.

Cincturing consists of removing a narrow ring of bark up to $\frac{1}{8}$ in. wide round the butt or fruiting canes. The incision is limited to the sap layer and is usually bound with a strip of waxed cloth to promote healing. While the cut is healing, circulation of the sap is checked and diverted to nourishment and formation of the fruit at the critical time.

Repeated cincturing on the butt and the accumulation of scar tissue ultimately weaken the vine. Cane cincturing is preferable, as injury to the permanent structure of the vine is avoided. Very good results have been achieved with cane cincturing by a single knife cut round each cane between the fourth and fifth bud.

To facilitate this operation a pair of grape trimming secateurs with the blades bent to form a pincer shape, like a crab's claw, have proved very useful. The cane is held between the curved blades and ringed with an up and down action.

Plant regulators have to a considerable extent replaced cincturing in commercial practice. Parachlorophenoxyacetic acid (PCPA), also known as 4-chlorophenoxyacetic acid (4-CPA) at a concentration of 20 parts per million (p.p.m.) in water has proved best to date. Optimum time of application is about a week after full bloom, when nearly all

flower caps have fallen from the bunches. PCPA is incompatible with bordeaux, but can be mixed with the fixed coppers and sulphur if applied immediately.

Cincturing has improved the setting of Albany Surprise, which is sometimes very subject to faulty setting, resulting in small, green berries among the ripe ones.

Tipping or De-shooting

Tipping or de-shooting will divert nourishment otherwise expended on surplus growth into the development of fruit. Tipping is useful, but the removal of too much foliage weakens the vine and impairs its ability to mature the fruit properly.

Tipping is also beneficial in countering "coulure" or defective setting of the fruit. The best time varies with the form of coulure that is expected: tipping to counter failure of the blossom to set is best done just before the flower caps drop; it should be done a few weeks later where the aim is to guard against later abscission or falling of the berries that have set.

Tipping should not be done too early, because sub-laterals will be forced out, thus providing new growing tips to compete again with the formation of the fruit. Any sub-lateral growth causing congestion of the foliage should be removed to improve spray coverage and increase air circulation.

Thinning Table Grapes

A vine can only ripen a certain quantity of fruit to perfection. Excess bunches should be removed from overloaded vines soon after fruit set.

The quality of the fruit can be improved further by reducing the number of berries in the cluster. With tight-bunched varieties, for every one berry left, two may be cut out and the bottom third of long bunches and any overhanging shoulders should be removed.

VINE NUTRITION

Of the substances which the vine takes from the soil the elements removed in greatest quantity are nitrogen, potassium, and phosphorus (major elements). It has been calculated that from an acre of vineyard a 6-ton crop of grapes removes amounts equivalent to only about 1 cwt of sulphate of ammonia, $\frac{1}{4}$ cwt of superphosphate, and $\frac{1}{2}$ cwt of sulphate of potash.

In addition small quantities of calcium, magnesium, sulphur (minor elements), and minute amounts of iron, zinc, manganese, copper, boron, and molybdenum (trace elements) are essential for normal growth.

In most soils trace elements are sufficient, and manurial practice consists mainly in replenishing the nitrogen, phosphoric acid, and potash used by the vine and removed annually from the vineyard by cropping. Liming takes care of calcium requirements and sulphur is supplied as an incidental component of most fertilisers, but magnesium can become deficient in some soils unless serpentine superphosphate or dolomite lime is used sometimes.

Trace Elements

Instances of abnormal growth from trace element deficiency are uncommon in New Zealand and no plant damage from natural excesses has been recorded.

Boron: In the South Island a case of unhealthy vine growth with fruit that was not uniform in size and developed a rot was investigated

A clover cover crop cut at ground level and folded back to show numerous seed burrs. The seed matures in November.

by the Cawthron Institute and shown to be due to boron deficiency. This was successfully remedied by the addition of 2 oz of borax per vine every 5 years. Overseas reports have shown that a similar condition, called "hen and chickens" by growers, is caused by boron deficiency, which prevents proper setting of the bunches so that parts of or whole bunches consist of undersized, seedless berries. A spray of 4 lb of borax per 100 gallons of water about 2 weeks before blossoming is also an effective treatment.

Zinc: A zinc deficiency causes stunting of the foliage and may be corrected by a spray of 5 lb of zinc sulphate and 2½ lb of hydrated lime per 100 gallons of water. Fungicide sprays containing zinc, such as ziram, are also effective.

Iron: On soils high in lime, vines sometimes suffer from a deficiency of iron characterised by chlorotic or yellowish-green leaves. A remedy is a strong solution of iron sulphate applied immediately after pruning.

Application of iron chelate compounds to the soil is also effective.

Manganese: Manganese deficiency is likely after excess lime applications to light soils. It shows in the foliage by the veins remaining green while interveinal tissue is pale yellow. To correct, spray with 3 lb of manganese sulphate and 1½ lb of soda ash or washing soda per 100 gallons of water.

All sprays to correct trace element deficiencies are more efficient if a good wetting agent is added.

Vine manuring experiments conducted overseas on a wide range of soil types have rarely given spectacular results. These investigations have mostly indicated that organic matter and total nitrogen content of the topsoil are the main criteria of fertility, and inorganic fertilisers may be applied to best advantage to encourage cover crops.

Organic Matter and Green Crops

Increasing the organic matter in the soil in vineyards to any extent by applications of farmyard manures, prepared compost, fowl manure with litter, and the like, though desirable, is generally too costly.

In some special cases it may pay to use organic manures to effect rapid soil improvement.

In some old vineyards on clay soil at Henderson where the fertility was seriously depleted the vigour and cropping of the vines were greatly improved after several annual applications of fowl manure and accompanying litter applied at 3 to 4 tons per acre. This manure is best applied in autumn, this time of application giving it all winter to decompose and become available to the vines the following season. On hilly country where there is a danger of erosion such manures should be applied as a surface dressing. The weed growth encouraged will bind and hold the manure from scouring.

For economic reasons, however, the vigneron must necessarily depend mainly on the production of good cover crops for maintaining organic matter. To this end fertilisers should be applied mainly for nourishing the cover crop and only indirectly the vines. This is the first principle of good soil management.

A range of cover crops is suitable to improve fertility. In most cases a leguminous cover crop such as blue lupins or subterranean clover is most suitable. Such a cover crop will supply practically all the nitrogen requirements of the vines and the application of additional nitrogenous manures could give trouble with defective setting, poor colouring, and possibly disease.

The cover crops most commonly used in vineyards with sowing rates per acre are:

	lb		lb
Blue lupins	90	Subterranean clover	12
Dun peas	90	Barley	90
Oats	60	Rye	90
Mustard	6	Rape	6

Lupins, subterranean clover, and peas should be sown with 2 cwt of superphosphate. Cereals (rye, oats, barley) and other non-legumes should be sown with 1 cwt of sulphate of ammonia in addition to 2 cwt of superphosphate to promote a good stand. Of the cereals rye gives the best yield on poor ground and is often the best to use when the growing of cover crops is beginning. Peas show seasonal variations in growth, but in a good year will outyield cereals and have an advantage in not requiring nitrogenous manures. A mixture of peas and cereals usually outyields either alone, and a suitable seeding rate is 1 bushel of cereal with ½ bushel of peas per acre. Mixtures should be sown with 2 cwt of superphosphate and ½ cwt of sulphate of ammonia.

The grower may need to experiment to determine which cover crops do best on his land. If the soil is well supplied with nitrogen, which will show in the vigour and bright green of the vine foliage, it would be imprudent to introduce excess nitrogen with legumes. Often a rotation of cover crops is best.

Sowing is best before the end of March. Late sowing when the ground and weather are cold gives disappointing results.

Broadcasting the seed and covering by harrowing is superior to drilling, which is inclined to place the seed too deep. Cover crops should be turned in not later than the middle of August to avoid nitrogen starvation of the vines at bud-burst; the intensified bacterial activity during decomposition temporarily draws on most of the available nitrogen.

A rotary hoe is ideal for turning in cover crops, as it breaks the crop into small pieces which quickly rot down. Cover crops should not be turned in deeply, as this retards decomposition.

Subterranean clover has proved eminently successful as a cover crop for vineyards and orchards in many parts of Australia, where it has proved superior to other cover crops in many respects. Trials with subterranean clover in New Zealand appear promising and its more extensive use as a cover crop seems probable.

There are several requirements to observe for the successful establishment of subterranean clover. In vineyards in South Australia an early-maturing strain of subterranean clover called Bacchus Marsh has excelled. Late-maturing strains of subterranean clover are entirely unsuitable. Both the Bacchus Marsh and Mt. Barker early strains of subterranean clover do well in New Zealand. Good establishment has been secured with 5 lb of seed per acre. Seeding must be early, preferably not later than mid March, to obtain the benefit of autumn rains.

A firm seed-bed is essential for successful germination, for which reason deep cultivation must be discontinued after mid January. The seed should be sown with superphosphate at 2 cwt per acre. If the soil is deficient in lime, a dressing of about 3 cwt or more per acre is necessary. On no account should superphosphate and lime be mixed with the seed when it is being broadcast, as chemical action will occur, impairing the germination of the clover. The seed is simply broadcast on the land, no covering being necessary.

Clover is a failure on land with a deficiency of the trace element molybdenum. If this is known or suspected, a molybdenum superphosphate mixture should be applied instead of ordinary superphosphate. Molybdenum is required in such minute quantities that further addition is not required for some years.

This mixture, prepared ready for use, is obtainable from fertiliser merchants.

Another possible cause of failure may be the lack of suitable rhizobium bacteria in the soil. These bacteria, which live in nodules on the roots of the clover and fix atmospheric nitrogen, are indispensable. Cultures of rhizobium bacteria for inoculating the seed before it is sown are procurable.

Subterranean clover makes vigorous growth throughout winter, setting its seed and dying back in November (see page 56).

It finishes its growth cycle at an opportune time before competing with the vines in the dry, summer period.

In many Australian orchards subterranean clover has been allowed to take command of the ground cover, eventually excluding all weeds. No cultivation is done and the clover is allowed to seed and regenerate from season to season. In time a thick mat of clover residues builds up, enriching the soil with humus and acting as a mulch in retarding loss of moisture from the soil by evaporation.

At present it is too early to say whether this system in its entirety is suited to vineyards. The lush ground cover provided by the clover is conducive to fungous disease because of the increased humidity and restricted ventilation under the vine trellises. Ground cover also increases the risk of frost damage. The compromise of clearing under and alongside the trellises and leaving a strip of clover about 2 ft wide down the centre of the rows for maturing and seeding appears most practical.

If it is not possible to sow a proper cover crop, encourage volunteer weed growth by topdressing with 2 cwt of superphosphate and 1 cwt to 3 cwt of sulphate of ammonia.

Many growers sow cover crops only in alternate vine rows to leave a way clear for pruning. Where possible it is better to make a complete sowing and mow alternate rows for convenience during pruning.

Additional Manuring

The 2 cwt of superphosphate per acre recommended for addition with the cover crop provides the annual requirements for phosphoric acid. To avoid any likelihood of a potash deficiency, which could occur in time, 1 cwt of sulphate of potash per acre may be added when the cover crop is turned under, thus replacing the amount removed by the crop each year. When leguminous cover crops are grown sufficient nitrogen is usually supplied to the soil. With non-legumes the addition of 1 cwt of sulphate of ammonia usually meets full requirements and may be added when the cover crop is turned under in August.

In most soils an annual addition of 3 cwt per acre of lime is usually necessary to prevent the development of excess acidity in the soil.

On certain soils low in magnesium a deficiency of this element may occur unless dolomite lime or serpentine superphosphate is occasionally brought into the manurial programme.

Magnesium is an essential ingredient of chlorophyll, the green colouring matter of the leaves. Though not a major element like phosphoric acid, potash, and nitrogen, it is used by vines in significant quantities and is by no means a trace element.

Magnesium deficiency shows up most noticeably on the older leaves in autumn. While the main veins remain green, the rest of a leaf develops a yellow mottling and the leaves fall prematurely.

A potassium deficiency can cause poor colouring of the berries and the leaves may have a yellowish mottled appearance with the tips and edges scorched. Spongy pruning wood is another symptom.

Typical of phosphorus deficiency is a general unthriftiness of the vine, early development of autumn colouring, and premature leaf fall.

Lack of nitrogen causes pallid foliage, stunted growth, and poor crops.

Don't Over-manure

A common misconception among grape growers with manuring arises from a belief that if a little does good, a lot will be much better. Nothing could be further from the truth, as excess fertilisers can be quite harmful.

An excess of any plant food can be either toxic to plants or act to repress availability of other elements. High levels of available phosphoric acid repress the availability of many trace elements, including zinc. Both phosphate and potash accumulations can render magnesium unavailable. A lack of nitrogen can also aggravate a magnesium deficiency.

Lime, and basic slag which contains lime, can also be used to excess. If the soil reaction becomes alkaline or nearly so from excess lime, the trace elements iron, manganese, boron, zinc, and copper become unavailable; molybdenum is the exception. A soil reaction of about pH 6.5 appears optimum for vines.

DISEASES AND INSECT PESTS

The grapevine is subject to attack from a number of diseases and insect pests and a knowledge of them and of the specific control measures to apply is most essential for successful culture.

The degree of immunity to troubles varies with the variety of vine. American vines, especially those close to the elemental species such as are used for phylloxera-resistant stock, generally are somewhat more resistant than European varieties, but individual varieties of both types show considerable variation in this respect. The resistance of most of the hybrid types depends largely on the ratio of American to European parentage in the cross and on the individual resistance of the varieties involved. Two of the commonest fungous diseases, oidium and downy mildew, are indigenous to America; it is understandable, therefore, that American vine types have acquired a certain degree of immunity to them. Phylloxera, the insect most destructive to European vines, also originated in America, and many American varieties are completely immune to serious injury from this pest.

Weak growth and soft, rank growth are less resistant to damage from fungous diseases and insects than strong, normal growth.

A factor conducive to disease is poor air circulation in the vineyard, which produces pockets of stagnant, humid air and retards drying of the foliage and fruit after rain. Proper trellising and training of the growth to prevent congestion, improve air circulation, and facilitate penetration of sprays are essential in maintaining the vineyard in a healthy condition. Unrestricted weed growth beneath the trellis, which impedes ground draught, or a too-dense shelter belt also results in poor circulation of air.

Good general management of the vineyard plays an important part, in conjunction with spraying, in achieving satisfactory control of diseases and insect pests.

It is much easier to prevent diseases by spraying than to cure them, for once the fungus mycelium has entered the tissues of the vine it is beyond reach of fungicides.

All fungous diseases of the vine are encouraged by warm, moist conditions. In Auckland and areas north of Auckland these conditions prevail to a considerable extent in most seasons, and to achieve effective control spraying has to be done at 2-weekly intervals at least through-

out most of the growing period. This frequent spraying is necessary to put a protective covering of fungicide on the new growth the vine is continually making and to replace previous spray deposits washed off by rain. In Hawke's Bay and other parts with a less humid climate fungous diseases are not so prevalent.

The action of a fungicide is to destroy the spores or "seed" of a fungus before or soon after germination and thereby prevent the germinating tube from entering the tissues of the vine. The efficiency of a spray depends mainly on the completeness with which all the herbaceous or green parts of the vine are covered, and for mature vines in full foliage about 150 gallons of spray per acre are needed to give thorough coverage.

Fungous Diseases

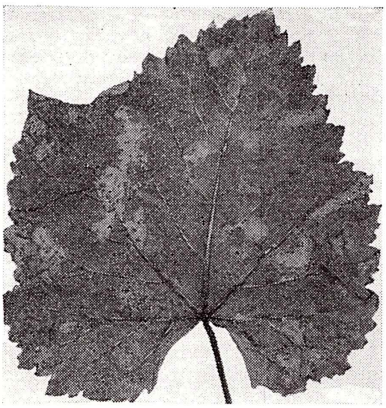
Downy Mildew (*Plasmopara viticola*)

Downy mildew appears first on the upper surface of the leaf as a discoloured, irregular patch of slightly paler and more transparent hue than the rest of the leaf; hence the French term, "oil spots", for it. Downy mildew also attacks growing shoots and bunches.

In moist conditions the under surface of the patch becomes covered with a dense white down. This is rarely seen on the upper surface of the leaves or on the shoots or flowers, but it is not unusual for the fungus to attack the fruit. If berries are attacked early in the season, the flesh has a greyish-white appearance and later dries up. This form of the disease has been termed grey rot or bunch mildew. If the attack occurs when the fruit is further advanced, berries become discoloured (a dull red), soften, and fail to ripen. The disease in this form has been termed brown rot. When berries begin to change colour the fungus does not attack them.

Leaves are most subject to attack and even in a mild case the crop suffers indirectly, because the functions of the leaves are disordered. Downy mildew can be responsible for premature leaf fall, which, when serious, will prevent the fruit from ripening, as the sugar is manufactured in the leaves before it is transferred to the berries. The vigour of the vine is also seriously affected, as leaves serve to ripen the canes and manufacture foodstuffs for nourishment and storage in the vine for a healthy start the following spring. Warm, wet conditions favour the development of downy mildew, and under these circumstances it is able to spread with extreme rapidity, even from a small source of infection.

Downy mildew forms hardy spores which hibernate in the remains of infected leaves and in the outer scales of the vine buds. These spores are spread by wind and the splashing of rain. When conditions are suitable, infection is established after an incubation of about 7 days and the characteristic oil spots appear. Shortly after, masses of spore bodies show on the under surface of the leaf as a white down.



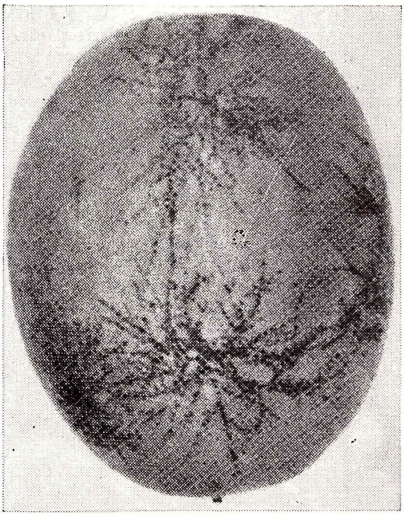
Downy mildew on under side of leaf.

Vine defoliated by downy mildew.

Control

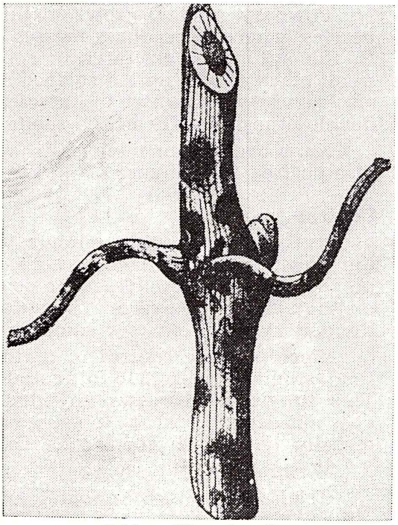
The most effective spray for controlling downy mildew is freshly prepared bordeaux mixture. Under most conditions a 4 : 4 : 100 formulation is satisfactory, if it is thoroughly applied to give proper coverage of the leaves and bunches. If wet, humid conditions prevail, which favour spread of the disease, spraying should be repeated about every 10 days. Many new spray materials, such as thiram, ziram, zineb, ferbam, and captan have been tested for control of downy mildew, but have not proved as efficient or economical as bordeaux mixture. The only objection to bordeaux mixture is that its copper content is mildly toxic to the vines. Copper sprays cause hardening and stunting of the foliage to a degree and act as a poison to the enzyme system of the plant, retarding such vital functions as sugar formation. Copper oxychloride and colloidal copper sprays, though not quite as efficient as bordeaux mixture, are somewhat less phytotoxic. Because of this and the greater convenience of preparation, copper oxychloride (3½ lb to 5 lb per 100 gallons) and colloidal copper (1 gallon of 13 percent in 100 gallons) have been used extensively in place of bordeaux mixture. Colloidal copper spray leaves very little residue on the grapes and is useful for dessert varieties.

The undesirable effects of bordeaux mixture in depressing growth and retarding ripening are reduced to a minimum if a low concentration, such as 4 : 4 : 100, is used. Copper sprays also control bacterial blight or blast.



[*After Queensland Department of Agriculture photo.*

Berry showing dark markings left by oidium infection.



[*After Victorian Department of Agriculture photo.*

Black mottling of vine canes caused by oidium.

Oidium (*Uncinula necator*)

Oidium, which is also known as powdery mildew, attacks all green growing parts of vines, including the fruit, and appears as a very fine dusty film which gradually becomes greyish, with a typical mouldy smell.

Oidium is easily distinguished from downy mildew. Downy mildew appears as a white, glistening down which is confined to the under side of the leaf, whereas the dusty film of oidium is most noticeable on the glossy, upper side, though it may also be present below. Oidium patches gradually become darker—because of the formation of dark markings on the vine parts—as a result of injury by the fungus to the surface tissues. The black markings, which rather spoil the appearance of table grapes, also occur on the canes. The most severe damage occurs when the bunch is affected, and if this happens before or shortly after flowering, the flowers and small developing fruit, which become covered with the mildew, soon dry up and drop off. When older fruit becomes mildewed, the skin is damaged and splitting usually occurs.

Unlike downy mildew the spores of powdery mildew can germinate and infect the vine in the absence of moisture such as a droplet of rain. Germination of the spores and spread of disease take place at temperatures as low as 45 degrees F, though development is most rapid at 70 to 85 degrees F. These facts explain why powdery mildew is so prevalent in the drier climate of Hawke's Bay, where it is the main disease problem.

The spores, which are spread by the wind, germinate overnight and send root-like filaments called haustoria into the surface cells of the vine and its fruit.

Powdery mildew grows mainly on the surface of the foliage and berries, where it produces masses of spores which spread the infection. In the autumn overwintering spores are produced, which appear as small black specks on the surface of the grape tissues. Powdery mildew also survives the winter by infection of the bud scales. The disease will develop most rapidly in the shade.

Exposure of the bunches to sunlight inhibits the disease and may also destroy the fungus.

Control

Dusting vines with sulphur will give good control of oidium, if the weather is warm enough to vaporise the sulphur. Sulphur may be applied with a knapsack or power-driven dusting device, depending on the area of vineyard. The sulphur used should be in a very finely divided state, as coarser samples are not nearly as effective.

More positive control of oidium may be achieved by using 1 : 200 lime sulphur, with 2 lb of colloidal sulphur added per 100 gallons. This fungicide possesses an advantage over sulphur dust in that it does not depend on heat to promote its activity, but there is a likelihood of mild burn with some vine varieties.

Wettable sulphur preparations are now being used extensively.

Trials show that colloidal sulphur is not nearly as efficient as either sulphur dust or lime sulphur for controlling oidium. At higher concentrations colloidal sulphur causes foliage damage on a number of varieties, especially on some of the hybrids.

Where control has not been satisfactory with sulphur dustings the main trouble has usually been the use of insufficient sulphur. The addition of lime to sulphur, a fairly common practice to facilitate distribution, lowers the fungicidal efficacy of the sulphur.

Depending on the season, four to six dustings are required. The most important times of application are (1, 2) when the shoots are about 4 in. to 6 in. and 12 in. to 18 in. long, (3) at blossoming, and (4) about 3 to 4 weeks after fruit set.

Once the powdery mildew fungus has infected the vines and started to produce spores sulphur dust is no longer fully effective. An eradicant spray is then necessary to kill the fungus. Such a spray, which has proved very effective in California, consists of 2 oz to 3 oz of laurel sulphate and 3 lb of wettable sulphur per 100 gallons of water. The foliage, canes, and fruit must be entirely covered with the spray. The laurel sulphate is reputed to eradicate the fungus and the sulphur forms a protective coating over the foliage until the next dusting time.

Black Spot or Anthracnose *(Elsinoe ampelina)*

Black spot or anthracnose appears on early spring growth and the most serious damage usually occurs before blossom time When vines are badly attacked at this stage the result may be destruction of the embryonic bunches, which are reduced to blackened and withered fruit stalks. The young leaves, tendrils, and shoots develop black patches of dead tissue, which lead to stunting and distortion.

The most characteristic symptoms are seen in the lesions on the canes. These appear first as small dark-brown or black spots, eventually producing open, black scars.

When the berries are attacked later in the season the fungus forms slightly depressed, scaly spots, with a greyish-pink centre and a dark-brown to black margin.

Moist conditions favour the spread of black spot. A wet spring or summer, even though the weather is cool, is conducive to the development of black spot, as, if conditions are moist, the disease seems able to develop at lower temperatures than many other fungous diseases. Unlike downy mildew, black spot is a slow-spreading disease.

The typical black scars produced by black spot are formed when it produces masses of spores which rupture the cuticle. These summer spores or conidia are spread by wind and only germinate in rain or dewdrops. Wet, humid weather therefore promotes the disease.

Black spot remains viable over winter in the diseased tissues by transforming into hibernating bodies called sclerotia. The sclerotia develop in spring, break through the cuticle, and form summer spores which spread the disease.

Varieties very susceptible to black spot are: Palomino, Muscat, Riesling, Sultana, Seibel 5163, Cabernet, and Chasselas. Other varieties possess a considerable degree of immunity; for example, the Pinots, Shiraz, and White Sauvignon. Susceptible varieties should not be planted in low-lying situations.

Control

Black spot may be controlled by spraying with thiram or ziram at 1½ lb (80 percent) to 100 gallons of water. Where a zinc deficiency occurs ziram is preferable. Neither thiram nor ziram is effective against powdery mildew, but both afford some protection against downy mildew.

The first spray should be applied at bud movement and a second 10 to 14 days later.

A third spray should be applied later if wet weather prevails. Copper sprays give part control and their use after thiram or ziram is helpful.

Botrytis mould on ripe grapes.

[*After U.S. Department of Agriculture photo*

Botrytis Rot *(Botrytis cinerea)*

Botrytis rot is most likely to occur late in the season if the weather is wet and warm. It appears to commence on some of the ripe berries that have split naturally or been damaged by birds or insects. It can spread rapidly, especially on varieties with tight bunches, which retain moisture. Infected bunches are covered with a felty mass of grey mould.

Control

Spray with thiram at 1½ lb (80 percent) to 100 gallons of water, plus a wetting agent.

Dead Arm *(Cryptosporella viticola)*

This fungous disease appears first as small reddish-brown spots mainly on the lower leaves and bases of green shoots. The leaf spots could be mistaken for black spot, but may be distinguished by holding the leaf up to the light. Dead arm infection spots are surrounded by a chlorotic halo lacking in those of black spot. Disintegrated infected areas on the leaf give it a tattered appearance.

Infection on the green shoots is mainly confined to the base up to the fourth node and, where deep, causes V-shaped slits or lesions. As the name indicates the most conspicuous symptom in an advanced stage is the death of one or both arms of the vine.

Not only the foliage and wood may be attacked, but also the flower clusters and later the berries at or near maturity. Damaged berries shrivel, mummify, turn greyish, and erupt spore pustules.

Control

The most effective control known is phenyl mercuric chloride (PMC) spray at ½ lb of active ingredient per 100 gallons applied at post-harvest and late-dormant stages. With a 2½ percent PMC spray material, 20 lb per 100 gallons of water, plus a wetting agent, would be needed.

Copper sprays, particularly up to the blossom stage, help prevent spread of the disease by inactivating any spores released.

Bacterial Disease

Grapevine Blast (*Pseudomonas syringae*)

Grapevine blast is caused by a bacterial organism called *Pseudomonas syringae*. This organism also attacks a range of fruit trees, ornamentals, and other plants.

The blast organism is most active in cold, wet weather, especially on the young, succulent growth in spring.

Infection causes the shoots to blacken, wither, and die back. Water-soaked dark-green spots appear on the green wood and brown to black depressed lesions on the mature wood. The symptoms resemble black spot to some extent.

Grapevine blast is a comparatively rare disease at present.

Control

Early copper sprays give reasonable control. More positive control is obtained by a streptomycin spray at a concentration of 100 p.p.m. One or two spray applications of streptomycin are usually sufficient, but if cold, wet weather prevails, a third application may be required. Allow an interval of 10 days between sprays.

Infected growth should be removed and burnt and pruning tools disinfected after operating on diseased vines.

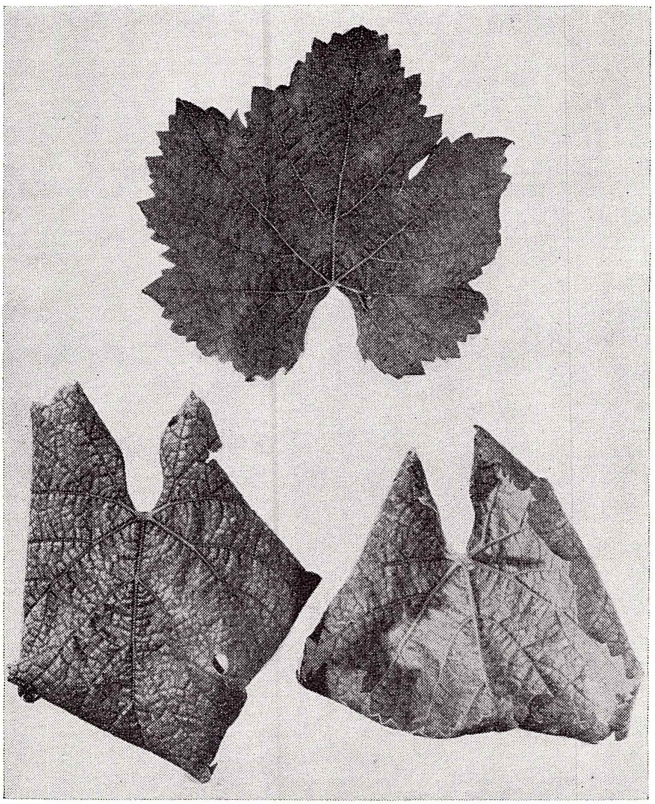
Virus Diseases

Virus diseases have caused extensive damage to grapevines in many parts of the world. Only leaf-roll and fanleaf virus diseases are known to exist in New Zealand, but isolated infections of yellow mosaic are suspected.

Leaf-roll

Investigations by the Plant Diseases Division of the Department of Scientific and Industrial Research have established that leaf-roll virus is fairly widespread in New Zealand vineyards.

Leaf-roll virus is a very insidious disease, as many varieties of vines are symptomless carriers. The main symptom is a downward roll of the leaf margins which varies with varieties and only becomes apparent about mid season on the older basal leaves. The roll develops progressively and later in the season shows on leaves near the ends of the canes. Other symptoms are brittle leaves, premature autumn colouring, deficient colour of the berries, reduced crop with low sugar content, and general debilitation of the vine.



[*D.S.I.R.*

Leaf-roll virus infection: Upper—Healthy leaf. Lower—Infected leaves.

Fanleaf

The symptoms of fanleaf are usually most evident on growth early in the season.

Infected leaves are deformed and, as the name suggests, the deformation pattern somewhat resembles a fan because of the exaggerated serrations on the leaf margins, prominence of the veins, and widening of the petiolar sinus.

Leaf distortion from 2,4-D hormone spray injury resembles fanleaf virus infection.

Other symptoms of fanleaf are mottling of the leaves, weakened, twisted growth with short internodes, and defective fruit set.

Control

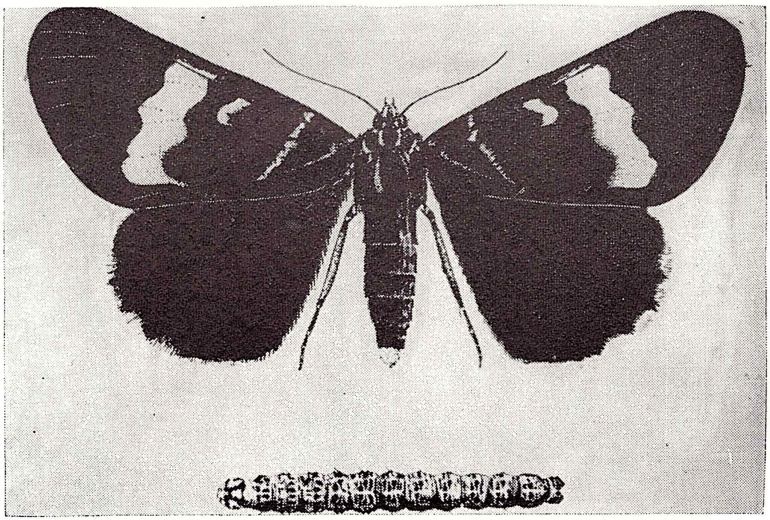
Avoidance of infection is the only known method of control. Infection may be avoided by planting only disease-free stocks and scions. Unfortunately, this is difficult for a commercial grower, because the common 1202 stock is a symptomless carrier of leaf-roll virus and in many scion varieties detection is elusive. The only sure way of detecting leaf-roll virus in symptomless carriers is to index them by grafting on to a suitable indicator variety.

Some virus infections are spread by certain insects and eelworms, but so far no vectors or agents for spreading grape viruses have been found in New Zealand, though field evidence indicates there may be some.

Insect Pests

Grapevine Moth Caterpillar *(Phalaenoides glycine)*

The caterpillars of the grapevine moth, which found its way to New Zealand from Australia in recent years, damage vines by devouring the foliage and also attack the developing grapes. The moth, which is about 2 in. from tip to tip of expanded wings, has yellow markings on the forewings. The end of the abdomen and part of the legs



[*After Given*

Grapevine moth and caterpillar.

are reddish. The caterpillar, which is about 2 in. long when full grown, is greenish-yellow and patterned with black lines and spots. The head is yellowish and the hind end reddish.

Control

Include and apply arsenate of lead with copper sprays at 1½ lb per 100 gallons of spray, or, alternatively, use 1 lb of 50 percent wettable DDT or 1½ pints of 20 percent DDT emulsion per 100 gallons of bordeaux.

Leaf-roller Caterpillar (*Tortricidae*)

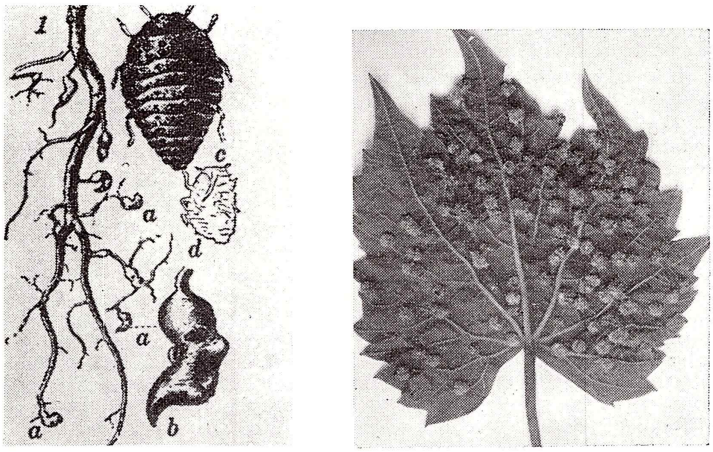
Leaf-roller caterpillars are small, green caterpillars characterised by the manner in which they draw the vine leaves together by fine, silken threads. They eat leaves and attack berries and fruit stalks at all stages of development; in ripe bunches the damage is usually followed by mould infection.

Control

As DDT is not highly effective at ordinary dosages for the control of this pest, lead arsenate at 1½ lb per 100 gallons is probably the best treatment. A very effective alternative is DDD at 2 lb (25 percent) per 100 gallons.

Phylloxera (*Phylloxera vitifoliae*)

The phylloxera insect is an aphid-like insect with a complicated life history; it spends most of its time infesting the roots as a tiny, yellowish, wingless female louse about 1/25 in. long. At this stage it multiplies without mating and swarms over the roots, sucking the sap and causing an irritation which produces bulbous, yellow, soft, watery swellings which eventually decay, destroying the roots. The insect, after a series of moults and changes, develops wings and flies away to other vines. There, on the undersides of leaves, it lays eggs



Left—The grape phylloxera. 1a—Root galls. 1b—Gall enlarged. 1c—Adult magnified. 1d—Side view of the insect showing proboscis used for sucking sap. Right—Phylloxera galls under a vine leaf.

which hatch into males and females. These mate and the females deposit winter eggs on the bark of the older wood. In spring these eggs hatch into wingless females and the young lice normally crawl up the canes to the leaves, where they puncture the upper surface, the irritation producing hollow galls, which protrude on the under surface. In the galls the females multiply without mating for a number of generations, the last of which returns to the roots, where it continues the insidious attack.

Control

The only satisfactory and practical method of control is to graft susceptible varieties on to phylloxera-resistant rootstock. Most fruiting varieties are destroyed by phylloxera if propagated on their own roots in infested areas. Notable exceptions are certain hybrid vines incorporating resistant wild American species. However, a number of the heavy-bearing hybrid varieties do not possess sufficient resistance to flourish on their own roots and should be grafted. It is important to cut off any roots which may grow out of the scion, or the resistant stock may die and render the vine vulnerable to attack.

All areas north of and including Hawke's Bay are infested by phylloxera. It is against regulations to send vines from these infested areas to phylloxera-free areas west and south of Hawke's Bay, including the South Island, unless sterilised.

Mealy Bugs *(Pseudococcus maritimus, adonidum,* and *comstocki)*

Mealy bugs can be a serious pest in the vineyard. They are small, flat, torpid creatures which look as if they have been sprinkled with flour. They suck the sap from leaves and berries, leaving a sticky, sweet secretion on which a black, sooty fungus develops.

Control

In most cases severe infestations of mealy bugs have followed the destruction of their natural enemies or predators by insecticides. Among active predator insects are certain ladybird beetles, which if encouraged will limit the mealy bug population.

To obtain full benefit from biological control it is advisable to use insecticides only when insects are causing material damage.

By allowing a certain amount of ground cover to grow in the vineyard predator insects can be encouraged.

If mealy bugs are present in considerable numbers and appear to be on the increase, the use of suitable insecticides is unavoidable.

Apply malathion (50 percent) emulsion at 1½ pints to 100 gallons of water. Two or three applications at 10-day intervals may be required, according to the severity of infestation.

Thrips *(Heliothrips haemorrhoidalis)*

Thrips are tiny, dark, slender, active insects which are occasionally responsible for the failure of berries to set. They become active at the flowering period and, by infesting the flower stalk and sucking the sap, starve the embryonic berries, which atrophy and fall off. A most susceptible variety is Early Malingre, which otherwise can mature an excellent crop of high-quality wine grapes in New Zealand. Thrips can be detected by tapping a bunch at the flowering stage into the palm of the hand; if thrips are present, this will dislodge myriads of them.

Control

Spray with DDT emulsion at 1½ pints (20 percent) per 100 gallons or malathion at 1 pint (50 percent) emulsion per 100 gallons.

Erineum or Vine Mite *(Eriophyes vitis)*

The vine mite is a microscopically small insect which punctures the lower surfaces of vine leaves and produces characteristic blisters on the upper surface. Under these blisters, from where the leaves are punctured, white felty masses of hair are developed called erinea. Vine mite damage is rarely serious to the vine or crop; it has sometimes been confused with downy mildew by untrained observers.

A strain of this mite exists which damages the buds, causing stunting and distortion of the shoots.

Control

Treatment should be the same as for powdery mildew. As the mite hibernates under bud scales, a 1 : 10 lime sulphur spray at the dormant stage is an active deterrent.

Borers *(Oemona hirta,* etc.)

The activity of borers is confined mainly to the older wood of the vine, where its presence is indicated by a gummy exudation and an accumulation of wood crumbs.

Control

It is often possible to destroy the insect by probing with a piece of baling wire the tunnel it has made. If the insect is beyond reach, it may be asphyxiated by inserting a cotton-wool plug saturated with petrol, kerosene, or carbon bisulphide in the borer hole. Another method is to inject one of these chemicals into the hole with an oil-can and plug the opening with a piece of clay or grafting wax.

Cutworms *(Agrotis ypsilon, Heliothis armigera)*

Cutworm grubs chew the leaves at night and may defoliate young vines. During the day the grubs lie coiled and buried in the soil at the base of the vine. They grow to about 1 in. in length and may be coloured green, cream, or brown.

The adult moth lays its eggs in early spring on the young shoots and the grubs begin feeding as soon as the eggs hatch. Weed growth encourages the pest.

Control

Spray the young vines with DDT emulsion at 1½ pints (20 percent) per 100 gallons.

Grapevine Weevil *(Phlyctinus callosus)*

The grapevine weevil causes considerable damage by eating the leaves, shoots, and bunches. The beetles are very numerous when the growth is tender, but become less evident as the fruit and wood mature. Where stalks have been chewed the scars surrounded by dead tissue somewhat resemble damage by black spot. As the beetles eat mainly at night and hide beneath old bark and twine and in other places during the day, they are not seen readily.

Control

Arsenate of lead or DDT should be used as recommended for destruction of caterpillars.

Red Spider *(Tetranychus urticae)*

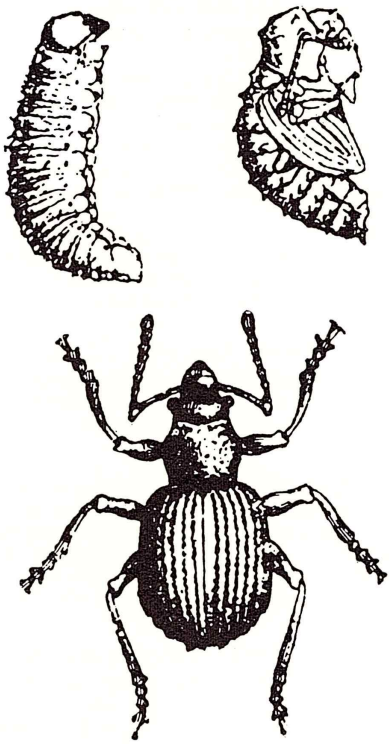
The red spider mite is mainly a pest of glasshouse grapes, though isolated instances of damage from this pest have occurred on outdoor vines.

The mites are very small and can be seen properly only with a magnifying glass. They suck the sap from the grape leaves and produce chlorotic spots. The mites thrive in hot, dry weather and weaken the vines by affecting the nutritional functions of the leaves.

When infestation is heavy the young leaves may be stunted and distorted, while the older leaves turn reddish and fall prematurely. A delicate webbing is produced on the undersides of the leaves.

Control

The incorporation of wettable sulphur and dusting sulphur in the spray programme serves as a deterrent to red spider. More positive control may be obtained by spraying with malathion at 1 pint (50 percent) emulsion per 100 gallons of water.



Stages in development of the grape vine weevil. Upper left—Larva. Upper right — Chrysalis. Lower — Mature weevil (actual size 1/3rd in.).

Root Eelworms

Damage of vine roots by eelworms or nematodes has been rare in New Zealand. The roots are penetrated by the nematodes, which cause swellings somewhat similar in appearance to those formed by phylloxera infestation, but usually much larger and softer. As the eelworms are about $\frac{1}{100}$ in. long, they can be seen only with a microscope. Excessive moisture and high soil temperatures favour the pest, which can seriously weaken vines by destroying the feeder roots.

A larger eelworm known as the dagger nematode is about $\frac{1}{20}$ in. long and is known to spread virus diseases of vines, but this species has not yet been found in New Zealand vineyards.

Control

Improved drainage will sometimes help in control. Injection of the soil with carbon bisulphide ($\frac{1}{2}$ oz per square yard) has been effective when done in October, as at this time eelworms are moving about in the ground. Some stocks such as *Solonis* x *Orthello No. 1613* and *Riparia gloire* are fairly resistant to eelworms.

A new compound, sodium methyl dithiocarbamate, has been used in vineyards overseas against eelworm infestation. It is reported to have given control, with increased vigour of the vines after treatment resulting in appreciable crop increases. Sodium methyl dithiocarba-

mate is sold in liquid and granular forms and in fertiliser mixes and, according to reports, can be applied round growing vines without harming them.

Brown Beetle (*Costelytra zealandica*)

The brown beetle, which is about ½ in. long, is the adult of the New Zealand grass grub. The beetle is on the wing at dusk during November and early December and is capable of causing considerable damage by feeding on the foliage of the vine.

Control

The same sprays as recommended for grapevine moth should be used.

Lecanid Scales (*Eulecanium corni* and *persicae*)

Lecanid scales are brown, elongated, oval creatures up to ¼ in. long which adhere to the woody parts of the vine and live by sucking the sap. If sufficiently numerous, they will seriously debilitate the vines.

Control

Apply lime sulphur 1 : 10 or winter oil 1 : 25 at the dormant stage. Vines in foliage may be sprayed with summer oil 1 : 100 if this treatment appears necessary, but the most effective treatment is to spray with winter oil at the dormant stage. Scale is not apparent where lime sulphur 1 : 10 is applied as a routine practice each year just before bud burst.

CONTROL OF DISEASES AND PESTS

The occurrence of diseases and insect pests is so variable with seasonal conditions, varietal susceptibility, and other factors that a general spray schedule to suit all circumstances is not possible. Advice on spraying programmes should be sought from the Horticultural Advisory Officer, Department of Agriculture.

Precautions with Spray Chemicals

Many sprays, particularly insecticides are toxic to humans. Take these elementary precautions:

(a) Store chemicals in a safe place out of the reach of children.

(b) Read the label on chemical containers carefully.

(c) Take special care when handling the concentrated chemicals to avoid contact with skin, eyes, and mouth. If necessary, wear an approved respirator and protective clothing.

(d) Avoid smoking or eating while spraying.

(e) Thoroughly wash exposed parts of the body after spraying.

Because spray residues on fruit may exceed tolerances permitted under the N.Z. Food and Drug Regulations, growers must avoid using chemicals so near to harvest that residues could cause concern.

Growers must observe the recommended waiting periods for chemicals which are shown on the container label.

In terms of the Agricultural Chemicals (Insecticides) Regulations 1964, growers must apply for a permit to use certain insecticides on horticultural crops.

Advice concerning the insecticides for which a permit is required, and application forms for a permit, may be obtained from the nearest Horticulture Division office.

NOTES

To protect bees avoid using contact insecticides close to flowering.

Don't use captan on wine grapes late in the season. Captan residues on grapes can retard or inhibit fermentation.

Trial work has shown that the fungicides maneb, zineb, D.P.T.D., P.E.T.D., and certain other recent introductions give satisfactory disease control and are less toxic to the vines than copper sprays. Possibly some compromise between copper and other fungicides will eventuate, such as the application of copper sprays at post harvest, bud burst, pre-blossom, and when the berries are about half size, with the necessary intermediate applications of newer fungicides.

Recently some large commercial vineyards have obtained very good control of most fungoid diseases with two new fungicides, metiram and a dithiocarbamate compound containing zinc and manganese.

With wine grapes spray markings on the fruit are unimportant and sulphur dustings are usually unnecessary in addition to the sulphur incorporated in the copper oxychloride sprays. In localities where powdery mildew is a problem supplementary sulphur dustings are, however, advisable.

For chewing insects such as caterpillars and beetles incorporate lead arsenate at 1½ lb or carbaryl at 1½ lb per 100 gallons of copper oxychloride, thiram, ziram, or bordeaux sprays. For mealy bugs, thrips, and other susceptible sucking insects incorporate 1½ pints of malathion (50 percent) emulsion per 100 gallons of copper oxychloride. Malathion is incompatible with bordeaux.

Because of a wider range of compatibility with other spray chemicals, lower phytotoxicity (less damaging to plant tissues), and convenience in handling, copper oxychloride and other neutral copper compounds have mainly superseded bordeaux.

Because of its efficiency, low mammalian toxicity, and comparatively short residual action, malathion has superseded many of the older insecticides.

Methoxychlor, a fast-acting insecticide of low mammalian toxicity, may be mixed with malathion for increased insecticidal potency. The usual rate is 3 lb of 50 percent methoxychlor wettable powder to 1½ pints of 50 percent malathion emulsion per 100 gallons. Both these insecticides are comparatively safe to handle and may be applied to edible crops up to 10 days from harvest without risk of toxic residues.

Rogor has mostly proved satisfactory as a general purpose insecticide. It has a systemic action by permeating plant tissue and moving in the sap stream, thereby controlling insects not contacting the spray or its residue on the leaf.

Preparation of Bordeaux Mixture

As the strength of bordeaux mixture is varied extensively, a recommendation for this spray usually includes the recipe. The weight of copper sulphate (bluestone) is indicated in pounds by the first figure, the weight of hydrated lime or quicklime in pounds by the second, and the volume of water in gallons by the last figure. Thus bordeaux 4 : 4 : 100 = 4 lb of copper sulphate, 4 lb of lime, and 100 gallons of water.

The required weight of powdered bluestone is put into the tank while the water is running in and the agitator working. When the tank is about three-quarters full the copper sulphate will have dissolved. The required addition of a good-quality, fresh hydrated lime, which has been mixed in a bucket with water, is then run into the tank and the load completed.

Lead Arsenate

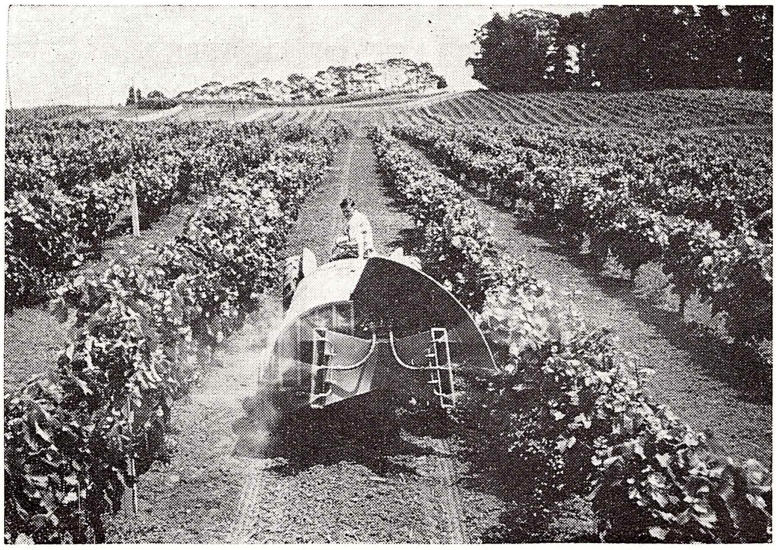
A preliminary soaking of the lead arsenate powder assists dispersion. If lead arsenate is used with bordeaux, it must be added after the bordeaux is mixed; if lead arsenate is used with colloidal sulphur and bordeaux, it should be added last. Where lead arsenate is used in combination with lime sulphur spray, add 6 lb of hydrated lime per 100 gallons of lime sulphur before mixing, to counteract the chemical reaction between the lead arsenate and lime sulphur.

Spray Equipment

Spraying with fixed booms is general practice in New Zealand, mainly because of economic advantages. Manually operated nozzles are very efficient in obtaining thorough coverage, but labour costs are high. With fixed booms no operator other than the tractor driver is engaged. Inefficient coverage from fixed-boom spraying in the past was caused mainly by unsuitable disposition of the spray nozzles and by systems of trellising which permitted congestion of the foliage, for which close-up, manual direction of the nozzles is needed to obtain proper penetration of the spray. The spreading of the foliage in a thin layer in the vertical plane by training it between double sets of wires, as explained in the section on trellising, facilitates spray penetration and adapts itself to fixed-boom spraying.

The provision of one or two low-set nozzles which come close to the vines and spray upward greatly improves results. If all nozzles are directed at right angles to the trellis, the leaves act as valves, closing up and preventing effective penetration of the spray into the interior foliage.

The high-pressure spray pumps used are driven from the power take-off from a tractor or by an independent engine. On level land the power take-off drive is satisfactory, but on hilly country it is difficult to maintain a constant speed sufficient to maintain full pump pressure, and a spray unit with an independent motor is preferable.



Turbo-mist sprayer in use at Te Kauwhata Research Station.

A master cock within convenient reach of the tractor driver should be provided so that the spray can be turned off when the driver is turning at the ends of rows; otherwise the waste of spray is considerable over a season's operations. The nozzles should be visible from the tractor so that blockages can be cleared.

When spraying with fixed booms is being done on slopes one boom tilts downward and the other upward, so that the spray misses some parts of the vines, unless a device is provided to keep the booms parallel to the trellis under these circumstances.

Air-blast spraying in semi-concentrate or low-volume form dries rapidly and becomes quickly fixed on the foliage, which is a big advantage in wet seasons.

PACKING TABLE GRAPES

Dessert grapes should be handled with extreme care in harvesting and packing to prevent damage to the bloom and bruising of the berries and stalks. Carelessly handled grapes deteriorate quickly.

It is also most important to allow the grapes to cool before packing to prevent sweating, which causes withering, moulding and rapid deterioration. A good policy is to pick one day and pack the next.

As grapes are usually displayed with one side of the container open, the bunches should be arranged so that no stalks show on either side. Begin packing by placing a bunch in the corners of the case, follow with bunches around the outside, and finish each layer in the centre. Repeat until the layers fill the box. The case is then carefully but firmly dumped on two spaced cleats nailed to the packing bench, which allows the case to spring slightly and avoids injury to the fruit. A smooth board with a handle at centre which just fits inside the case is used to secure the grapes while dumping.

The space left by the settling is then filled by a final layer as previously, but it may be necessary to cut some of the bunches to the required size. White paper should be used to line the cases before packing.

COLD STORAGE OF GRAPES

The recommended temperature and relative humidity levels for efficient long-term storage of Albany Surprise grapes is 30 to 32 degrees F and 87 to 92 percent relative humidity. Temperature maintenance is facilitated by proper arrangement of the grape containers by having air spaces and passage ways in the direction of the air movement in the refrigerated storeroom.

Grapes may be successfully held in cold storage from 3 to 6 months, depending on the variety and storage conditions. For long storage 15 to 20 p.p.m. of sulphur dioxide gas is maintained in the cold store to inhibit destructive moulds, mainly grey mould (*Botrytis* sp.).

Gaseous fumigation in a cold store involves a corrosion problem. The coils and other metal work require adequate protection by painting with special plastic materials.

Alternatively sodium or potassium metabisulphite, or sodium bisulphite, 10 to 15 grammes per box being used, may be mixed with the granulated cork or other packing materials.

Tablets weighing 0.7 gramme and containing 15 percent of sodium bisulphite, 4 percent of spermaceti wax, and 81 percent of alum placed with each bunch also efficiently reduce wastage. These chemicals slowly evolve sulphur dioxide in storage. In tablet form the sulphur dioxide gas is released more slowly over an extended period.

GRAPE VARIETIES

GRAPE varieties may be classified broadly into table and wine types. Generally the best varieties for wine making are not attractive table grapes, mainly because the berries are small. Some varieties of exceptional merit for wine making have an astringent taste and others possess a tart flavour and seem nearly all skin and seeds when eaten.

Table grapes have been bred and selected to produce fruit with large berries and an agreeable flavour, but most are capable only of producing a thin, characterless wine. Very few varieties are suitable for both table use and wine making. The most notable exceptions are some of the muscatel and Chasselas varieties. Over 2,000 varieties of grapes have been identified and recorded, but only about 50 are grown much in New Zealand. Grapes are classified botanically in the genus *Vitis*, the most important species of which is *Vitis vinifera*, which includes only, and all, grapes of European origin. There are, however, a number of native American species which, because of their inherent resistance to certain fungous diseases and insect pests and their adaptability to a wide range of growing conditions, have been particularly valuable in the breeding of hybrid varieties for rootstock and fruiting purposes. The development of some of these hybrids has made possible the extension of the geographical range of grape culture. The list on pages 78 and 79, prepared by the United States Department of Agriculture, summarises the characteristics of the varieties useful for breeding purposes.

Because of New Zealand's mild summer temperatures many of the varieties commonly grown in countries with a hot climate will not ripen here. Only fairly early-maturing varieties are of any value for viticulture in New Zealand. Late varieties can be ripened only under glass. Therefore the range of suitable varieties for outdoor grape culture is very limited. The ripening period of any variety may be described as precocious, early, mid-season, or late. Precocious varieties ripen from the middle to the end of February, early varieties in the first week of March, mid-season varieties during the second week of March, and late varieties at the end of March and in April if summer temperatures persist into that month. These ripening periods apply to the Auckland area in an average season; in Hawke's Bay and Northland grapes usually ripen a little earlier.

Even some of the mid-season varieties are not entirely satisfactory for the making of wine. This applies to some of the varieties with a high natural-acid content such as Baco 22A and Seibel 4643. The high natural acidity of such varieties is accentuated in a poor season when cool temperatures prevail in March. If wine were made from these varieties alone, it would be sharp and unpalatable because of the high tartaric acid and malic acid content. In a climate hotter than that of New Zealand ripening proceeds to a more advanced stage and the malic acid content is very small. The tartaric acid is also reduced and a greater proportion is partly neutralised by the intake of potash salts from the soil.

For wine making, grapes with a high acidity should be blended with those having low acidity; for example, Golden Chasselas and Merlot. It is also important to delay harvesting as long as is practicable to enable the fruit to attain the greatest possible degree of maturation. At this stage the sugar content and flavouring principles are developed fully and the acidity is reduced to a minimum. Grapes which attain this condition are superior for wine making or eating to less mature berries.

Grapevines sometimes exhibit peculiarities in behaviour which are hard to explain. Some varieties do better than others in a certain locality; others perform consistently well irrespective of where they

Grape Species Used in Breeding Hybrids

(From the Yearbook of the United States Department of Agriculture, 1937)

Species, common name, and natural range	Character of vine	Resistance to					Qualities for breeding
		Phylloxera *	Cold †	Heat †	Wet †	Dry †	
Vitis aestivalis Michx.; summer grape; New England to Georgia and westward to the Mississippi River	Vigorous, climbing; leaves large (20 cm.), three- to five-lobed	14	VG	G	F	G	Resistance to fungous diseases; high sugar percentage; suitable wine properties; possible table use if crossed with large-berried varieties
V. aestivalis var. *bourquiniana* Bailey (*V. bourquiniana* Muns.); Bourquin grape; origin doubtful; adapted to south-eastern States	Vigorous, climbing; leaves large, three- to five-lobed	....	F	G	F	G	Vigour; disease resistance; productiveness; coloured juice
V. berlandieri Planch.; Spanish grape, winter grape; Texas and northern Mexico	Medium vigour, slender; leaves medium (10 cm.), three- to five-lobed	19	F	G	F	G	Rootstock resistance to phylloxera; ability to grow on strong, limy soils
V. candicans Engelm.; the mustang grape; mainly Texas, parts of Arkansas, Oklahoma, Louisiana, and Mexico	Very vigorous, high climbing; leaves medium, non-lobed to three-lobed	15	F	G	F	G	Vigour for rootstock; is easily hybridised; adapted to black limestone lands; large-berried fruit for wild vine
V. champini Planch.; the Champin grape; mainly Texas	Very vigorous, climbing; leaves medium (10 to 12 cm.), non-lobed to three-lobed	15	F	G	G	G	Vigour for rootstock; healthy foliage; wide adaptability; large-berried fruit
V. cordifolia Lam.; frost grape; wide range, from Great Lakes to Florida	Vigorous, climbing; leaves medium (10 cm.)	18	G	G	G	G	Vigour; phylloxera resistance; wide natural range; poor fruit
V. labrusca L.; fox grape; New England to northern Georgia, westward to Indiana, and bordering the Ohio River	Medium vigour, climbing; leaves large, non-lobed to slightly lobed	5	VG	F	F	F	Cold resistance; large-berried fruit; strong, distinctive flavour

* Phylloxera resistance graded 1 to 20.

† Symbols for resistance to cold, heat, wet soil, drought: VG, very good; G, good; F, fair.

Species, common name, and natural range	Character of vine	Resistance to					Qualities for breeding
		Phylloxera *	Cold †	Heat †	Wet †	Dry †	
V. lincecumi Buckl.; pinewoods grape, post-oak grape; Texas, parts of Louisiana, Oklahoma, Arkansas, and Missouri	Vigorous, bushy to climbing; leaves very large, three- to five-lobed	14	F	G	G	VG	Vigour; disease resistance; large clusters and berries; strong flavour
V. longi Prince; Long's grape, bush grape; parts of Arkansas, Oklahoma, Texas, New Mexico, and south-eastern Colorado	Very vigorous, bushy to climbing; leaves large, three- to slightly five-lobed	14	G	G	VG	G	Vigour; phylloxera resistance; easy rooting of cuttings; vinous flavour
V. monticola Buckl.; sweet mountain grape; Texas	Medium vigour, slender, climbing; leaves small, non-lobed to slightly three-lobed	18	G	F	F	G	Phylloxera resistance; health of foliage; fruit medium to small
V. rotundifolia Michx.; muscadine grape; Potomac River to Florida and west to eastern Texas	Vigorous, slender, climbing; leaves small, not lobed	20	F	G	F	G	Disease-resistant vine and fruit; special fruit flavour
V. rupestris Scheele; sand grape; southern Missouri and Illinois, Kentucky, Tennessee, Oklahoma, and eastern and central Texas to the Rio Grande	Very vigorous, bushy, rarely climbing; leaves small, mostly non-lobed.	19	F	G	G	G	Phylloxera resistance; easy propagation; vigorous
V. riparia Michx.; river-bank grape; Canada to Texas and west to Great Salt Lake; wide range	Vigorous, slender, moderately climbing; leaves large, mostly non-lobed to slightly three-lobed	19	VG	F	G	F	Phylloxera resistance; cold resistance; easy propagation
V. vinifera L.; European grape, wine grape; introduced species	Medium to strong vigour, bushy to climbing; leaves mostly three- to five-lobed, occasionally seven-lobed	1	F	VG	F	G	Productiveness; high quality; easy propagation; some seedlessness.

* Phylloxera resistance graded 1 to 20.
† Symbols for resistance to cold, heat, wet soil, drought: VG, very good; G, good; F, fair.

are grown. In the same district and even in different parts of the same vineyard varieties may show variation in performance. Production from a variety has been known to decline for no apparent reason, and varieties have sometimes settled down to improved bearing some years after establishment. Crops have been greatly improved at times by raising vines from a low trellis on to a pergola trellis; the reasons may be that the vine has more scope and that humidity is lower in a more elevated position, which results in better setting of the fruit. It is only by trial that the most suitable varieties for a particular site can be determined.

The Vine Leaf

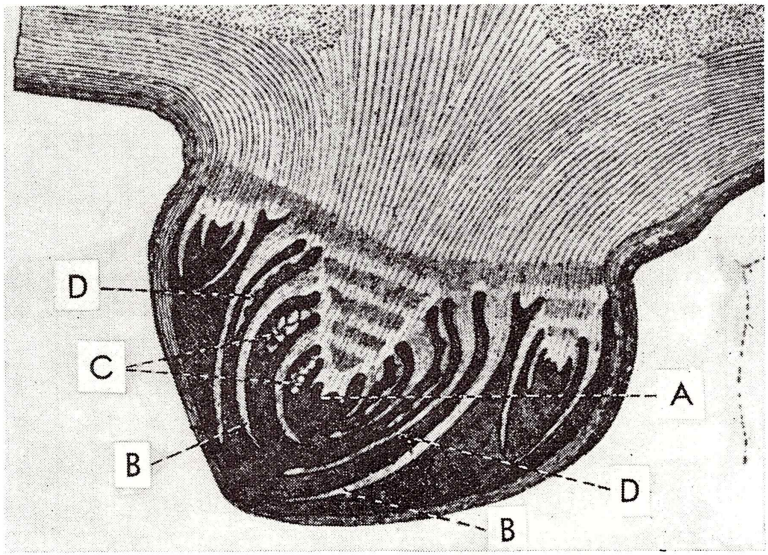
The shape of the leaf is typical of a particular variety. Differences in leaf form and other characteristics and the appearance of the fruit are the chief means of identifying varieties.

Some identifying features of leaves are: general shape and number of lobes; shape and size of serrations or teeth on edge of the leaf; shape of sinuses, particularly the petiolar sinus or indentation where the leaf stalk is attached; nature of leaf surface whether plain or hairy (glabrous or pubescent), puckered or smooth; and leaf colour.

Appearance and colour of the young shoots and tips are also of assistance in identification.

The Bud

On growing shoots there are two buds in each leaf axil where the leaf stalk is attached to the shoot. One of these buds usually develops during the season to form a lateral. Most of these laterals remain green and are shed with the leaves in winter. The other bud at the base of the leaf stalk remains dormant during the season it was formed and produces the foliage and fruit the following season. These buds are



[After Babo u. Mach in "Handbuch des Weinbaues"

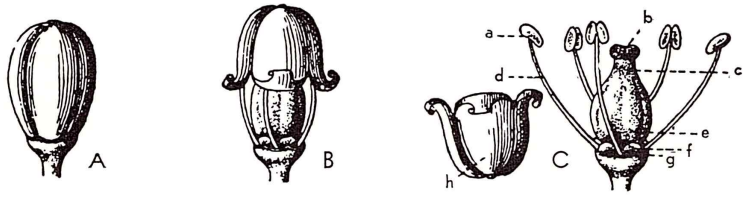
Magnified view of dissected compound grape bud. A—Main shoot. B—Rudimentary leaf. C—Rudimentary inflorescence (flower). D—Rudimentary tendril.

compound, usually consisting of a main bud and two subsidiary buds. Page 80 shows (magnified) a dissected compound grape bud in winter. It shows the main, large bud with rudimentary grape flowers and small, subsidiary buds, all of which in outward appearance seem to be a single entity. The main bud develops into a shoot the following spring and usually bears fruit; the small, subsidiary buds remain dormant. If, however, the original shoot is killed by hail or frost or is broken off, the subsidiary buds develop to take its place. Usually the subsidiary buds are not fruitful.

As the crop of one season is formed in the embryonic stage the previous season, growing conditions in the current season influence the crop in the next.

The Flower

Most cultivated vines have hermaphrodite flowers and are self-pollinating. The components of a typical grape flower are shown below. Flowers containing only male or female parts are found on certain wild American species. Examples of male vines are found in two common stocks, *Riparia* × *Rupestris* 3306 and 3309. In these the flowers have stamens, but no female part.



[*After Babo u. Mach in "Handbuch des Weinbaues"*

Hermaphrodite flower of the grape. A—Closed bud. B—Bud with corolla or cap lifting. C—Flower in bloom: a, anther; b, stigma; c, style; d, filament; e, ovary; f, nectaries; g, calyx; h, corolla.

Varieties Grown Successfully in New Zealand

Only a comparatively small proportion of the large number of varieties in existence have been tried in New Zealand. The varieties described are those which have been grown successfully in New Zealand, and these should serve as a guide to prospective growers.

The varieties listed which have a breeding number (for example, Seibel 5409) are hybrids of native American vines and European vine varieties.

The object of the breeding was to combine the good wine making or dessert qualities of European varieties and the hardy, disease- and pest-resistant characteristics of American species. Though one of the original intentions of breeding hybrids was to incorporate sufficient resistance to phylloxera from the American parentage to permit propagation of hybrids on their own roots as direct producers, most hybrids are usually insufficiently resistant to phylloxera to permit this with safety. Even so, the French hybrids Seibel, Couderc, Seyve-Villard series, etc., are usually referred to as direct producers. American hybrids such as Isabella, Diamond, Concord, etc., have a very diluted European parentage, whereas the French hybrids have a more pronounced European character. Grafting on to phylloxera-resistant stock is generally considered preferable, because most of the hybrids tend to become weakened through over-bearing, which makes them susceptible to

destruction by phylloxera, and a number have only a poorly developed root system. Hard pruning of vines on their own roots every second season will counteract the tendency to over-crop, but on a vigorous stock consistently heavier cropping can be sustained better.

The hybrid varieties have been a boon to New Zealand viticulture. Because of their resistance to disease and their fertility these hardy vines have made viticulture more economic than was ever possible with European varieties only.

Wine made from hybrid varieties has not the quality of that made from European grapes, though it is a fairly good general trade wine and acceptable to the average consumer.

It is desirable when planting a vineyard for wine production to include a proportion of European varieties to enable wine to be blended and its quality enhanced.

Red Hybrid Varieties

Albany Surprise

The variety most widely grown in New Zealand for table purposes is Albany Surprise, which is believed to be identical with the American variety Pierce. Albany Surprise is a mutation of the American hybrid variety Isabella selected from a vineyard at Albany, near Auckland.

Isabella is a hybrid of the American species *Labrusca* and a European variety all of which belong to the *Vinifera* species. Albany Surprise superseded Isabella because of its larger berries and better-formed bunches. When properly ripe it is acceptable as a table grape to most people. It has a pronounced flavour typical of the *Labrusca* species and many people prefer well-grown Albany Surprise to the more subdued and delicate flavour of European varieties.

Albany Surprise has been used to some extent for wine making in New Zealand. Fruit left on the vine into April—until it is dead ripe—makes a palatable, sweet red wine with a very prominent and distinctive flavour, which is pleasant if judged on its own merits and not by comparison with classical standards established by European wines. Pressed off the skins the juice of Albany Surprise grapes makes a fair, sweet white wine with a fruity character. Unless the fruit is really ripe, the wine is very poor.

A fault with Albany Surprise is its low sugar content, but this improves somewhat if picking is delayed until late in the season. The fruit weathers well and does not split like that of many varieties if left on the vine late in the season and wet weather occurs. Albany Surprise does well when grafted on to 1202, 3306, and 420A.

Baco No. 1 (*Riparia* × *Vinifera*)

Baco No. 1 is grown fairly extensively in New Zealand. It is a vine of prodigious vigour, producing large crops of small, black grapes loosely arranged in the bunch. In a good season it attains a high sugar content for a New Zealand-grown grape. Beaume readings on this variety have registered as high as 13.0 degrees in some years. Because of its remarkable vigour, it is not suitable generally for a low trellis and should be trained on a pergola to give it scope to exploit fully its cropping capacity.

Baco No. 1 is the most highly acid grape grown in New Zealand. A total acidity of as high as 16 gm. per litre at harvesting has been recorded. A large amount of this acidity is precipitated out of the wine during storage, but acidity is still too high to give a balanced wine, and blending with low-acid varieties to reduce acidity is necessary.

Another shortcoming of this variety is its poor resistance to wet weather. When ripe the berries split badly after a downfall of rain and shed a lot of juice.

Baco No. 1 has been used successfully as a stock vine, having special merit on heavy, wet, clay soils. It strikes root and grafts readily and produces vigorous, productive scions. It has the disadvantage of producing suckers freely and, unless carefully selected, the canes are often too pithy for good grafting material.

The must of Baco No. 1 ferments well and the wine clears rapidly. It attains its ultimate in quality only after several years' maturation. The wine has a clean, full-bodied flavour, a pleasant, non-foxy aroma, and an attractive colour.

The vine and its fruit are highly resistant to downy mildew, but less resistant to powdery mildew and black spot. The vine may be pruned to rods or spurs. Rod (long) pruning is most generally practised.

As it is one of the direct producers, Baco No. 1 is usually grown on its own roots and apparently has sufficient resistance to phylloxera not to require grafting. Its extreme vigour and prominent *Riparia* character account for its resistance.

Seibel 5437 (S. 867 × Alicante Ganzin × Piquepoul)

The Alicante Ganzin in the hybridisation has imparted an intense red colour to the juice of Seibel 5437. Most red varieties when pressed give an almost colourless juice, as colour is only in pigment cells in the skin. Varieties with red juice are known as teinturier varieties.

Seibel 5437 is a vigorous grower and a good, consistent bearer of dark-red, oval berries loosely arranged in the bunch. As the grapes are thick skinned and resistant to wet weather, they do not split and rot. Seibel 5437 is subject to erinose and black spot, but fairly resistant to other troubles. It ripens in mid-season and is used mainly for blending with less highly coloured varieties. As it is a vigorous grower and the leaves turn a dark russet colour in autumn, it makes an ornamental covering for a garden pergola, especially with a hardy white variety like Seibel 5409, which is an acceptable eating grape.

Seibel 5163 (2 Gaillard × 2510 (Alicante Ganzin × Piquepoul))

Seibel 5163 is a fairly vigorous grower and crops heavily. Its oval, thick-skinned, red berries are arranged loosely in the bunch. This variety is fairly resistant to wet weather. It is subject to oidium and black spot, but not to downy or powdery mildew. It ripens in mid-season.

Seibel 4643 (S. 29 × Danugue)

A vigorous red hybrid variety, Seibel 4643 ripens in the late mid-season period. The berries are bigger than average, thick skinned, and loosely arranged in the bunch. Crops are consistently good and the fruit produces a wine of fair quality, which is entirely *Vinifera* in character and improves with ageing. In the young wine acidity is rather aggressive. The vine and its fruit are subject to oidium and the grapes to weather spoilage, but are fairly resistant to other diseases.

Seibel 5455 (S. 867 × Alicante Ganzin × Duchess)

Seibel 5455 is not sufficiently resistant to phylloxera to permit, with safety, propagation without grafting on to resistant stock in infested areas. In recent years large numbers of Seibel 5455 vines on their own roots have been destroyed by phylloxera in the Henderson area. Wherever it has been grown in New Zealand, Seibel 5455 has exhibited vigorous growth and has excelled most other varieties in cropping ability. The small, dark-red berries are tightly packed in long, cylindrical bunches without shoulders. The bunches are so compact that a few of the berries are sometimes shed when full maturity is reached.

Seibel 5455 is fairly resistant to wet weather and mildews, but subject to chlorosis on limestone areas. When the fruit is allowed to

ripen well it makes a soft, pleasant wine of fair quality but tending to be neutral in character. The regular, good cropping of the variety and other qualities commend it as a very useful variety for New Zealand conditions. It is favourably reported on by the State Viticultural Station in Switzerland, where it is recommended for blending with Seibel 1000 to obtain a wine of good all-round balance. Seibel 5455 ripens during the early mid-season period.

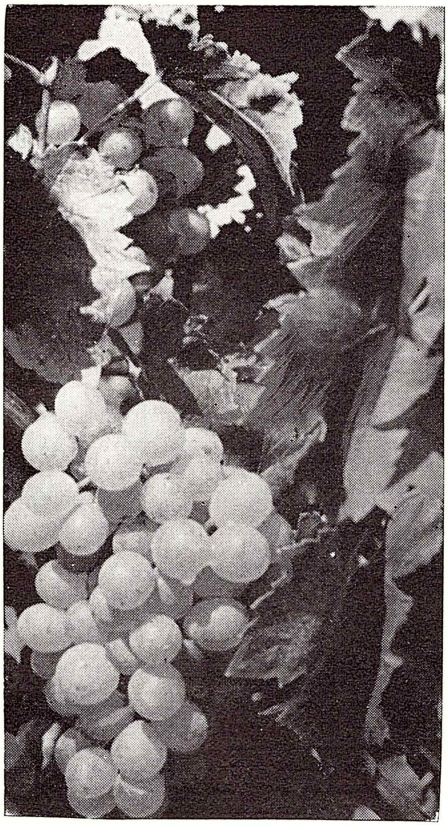
Seibel 7053 (S. 5163 × S. 880)

Seibel 7053 is a fairly vigorous vine capable of giving a fair-quality wine of good flavour, moderate colour, and entirely *Vinifera* character. The berries are red, thick skinned, and loosely arranged in the bunch. Cropping is very good and regular. Seibel 7053 has a high degree of immunity to fungous diseases, but is subject to erinose. It ripens in late mid-season. It is not damaged by wet weather. It is one of the best red hybrids.

White Hybrid Varieties

Seibel 5409 (S. 867 × S. 452)

A variety of moderate vigour, Seibel 5409 has pale-green to yellow berries in small, compact bunches resembling those of White Pinot. It regularly produces good crops which ripen in early mid-season. The foliage and fruit are resistant to fungous diseases, but the berries will split in a very wet season. The quality of wine from Seibel 5409 is particularly good for a hybrid variety. Seibel 5409 is one of the few hybrids recommended by the Swiss Viticultural Station at Lausanne.



[*Sparrow*

White hybrid variety Seibel 5409.

Seibel 5408

Seibel 5408 if grown on its own roots is weak; it should be grafted on to a vigorous stock. It bears large, regular crops. The berries are similar in appearance to those of Seibel 5409, but the bunch is loose. The variety's resistance to fungous diseases and wet weather is good, and the fruit ripens in mid-season. Its wine-making quality is fair.

A remarkable characteristic of this variety is that the secondary and adventitious buds are mostly fertile and capable of yielding quite a good crop if the primary shoots are destroyed by frost. It is thus a useful variety for areas subject to spring frosts.

Seibel 4986, Syn. Rayon d'or (S.405 × S.2007)

Seibel 4986 is an early-maturing white hybrid. It is a vigorous vine and produces good crops, except in humid positions. At Te Kauwhata its performance has been fairly poor, but it has done better in other districts. It is capable of producing a partial crop after a late frost, a valuable trait in some localities. Fruit clusters are small and compact with berries oblate. Berries develop a good sugar content and fairly good wine can be produced from them. In France it is considered one of the best hybrid white varieties for wine making. Seibel 4986 is grown in the Loire Valley.

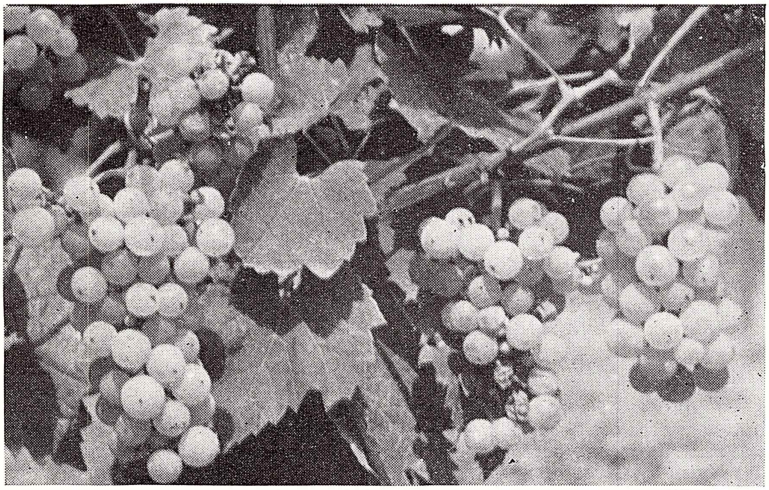
Gaillard Girerd 157 (Triumph × Eumelan × Seibel No. 1)

Gaillard Girerd 157 bears heavy crops of small, compact bunches. Because of its heavy-cropping nature and the moderate vigour of its growth, this variety should be grafted. It has good affinity with 1202 stock. It ripens in mid-season. The variety shows good resistance to disease, but the fruit splits and falls if conditions are wet when the crop is ripe. Its wine-making quality is fair.

Baco 22A (Folle Blanche × Noah)

Baco 22A is a late mid-season white hybrid of moderate vigour. It is a consistent bearer of good crops, though if allowed to carry large crops for a few years in succession, it loses vigour. For that reason it should be pruned to short rods and planted only about 6 ft apart in the row. Grafting on to a vigorous stock improves its performance. Its late-ripening habit is a disadvantage in New Zealand, but this is offset by its ability to withstand wet weather, which permits late maturation of the fruit. As the grapes have a slightly foxy flavour, they should be pressed and fermented off the skins for wine making. The wine making quality is fair when the fruit is properly mature, but the wine tends to be excessively acid and it should be blended with a low-acid variety to restore a balance. A pleasant dry white wine can be made from well-ripened Baco 22A grapes fermented off the skins.

In recent trials to assess the brandy-making potential of most of our intensively planted wine grapes, the results obtained with Baco 22A were encouraging. Probably Folle Blanche, one of the classical French brandy grapes, in the parentage of Baco 22A mainly accounts for its brandy-making qualities.



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Baco 22A, a consistent bearer of good crops.

Red European (*Vinifera*) Wine Varieties

Shiraz (Red Hermitage)

Shiraz is grown extensively in the Rhone Valley around L'Ermitage and in Australia. Shiraz is a corruption of the proper name, Syrah.

It bears medium crops consistently in most parts of New Zealand; crops are slightly heavier than those from Cabernet Sauvignon. The berries, which are bluish-black, oval, and loosely arranged in the bunch, are resistant to damage from wet weather. This is an advantage in the higher-rainfall districts, as the fruit can be permitted to mature late without its being exposed to the risk of splitting and developing mould infection as with the Pinot varieties, for example. In a normal season Syrah ripens about the middle of March.

Syrah is a quality red wine grape. The wine is full bodied and long lived and reaches its ultimate attainments after some years of maturation. A blend of Syrah and well-ripened Pinot makes a softer wine than that from Syrah alone and one which is more palatable at an earlier age.

Syrah possesses good affinity with most resistant-stock vines.

Pinot Saint-Laurent

Pinot Saint-Laurent is a vigorous-growing variety which bears good crops that ripen early. The berries, which are small, thin skinned, and juicy, are deficient in colour. The variety is subject to attack from black spot and erinose, but downy mildew and oidium are less troublesome. It does well when grafted on to 1202 and 3306 stocks. In wet weather berries tend to split and to be attacked by botrytis rot, though the early-ripening habit of the variety often safeguards it from damage. It makes a good-quality nicely balanced wine, but requires blending with a darker variety to deepen the colour.

Gamay Beaujolais

Gamay Beaujolais, a vine of medium vigour and fairly good cropping ability, has deep blue-black, medium berries tightly packed in the bunch. It is very susceptible to all the fungous diseases. The fruit ripens early, usually about the first week in March. Its resistance to wet weather is fair. It does well on 1202 stock.

Pinot Meunier

Pinot Meunier is a European variety of average vigour and fair cropping ability. The berries are small, thin skinned, juicy, and a bluish-black when fully ripe. Its bunches are small and compact and it ripens early—a little later than Pinot Saint-Laurent.

The variety is particularly susceptible to black spot, but downy mildew and oidium are less troublesome. The fruit is very subject to splitting and mould when rain occurs at the mature stage.

It does well on 3306 stock. Pinot Meunier is a good wine-making grape and worth cultivating despite some of its faults. Wine made from properly ripened Pinot Meunier is well balanced in acidity and tannin, clears rapidly, and mellows at an early age.

Melascone Nera

Melascone Nera is a fairly good bearing mid-season Pinot type with better resistance to wet weather than Pinot Meunier or Pinot Saint-Laurent. It is subject to black spot, but more resistant to oidium and downy mildew. It has affinity with 3306 and 1202 stock. The wine from this variety is low in acidity, tends to be neutral in character, and is better when blended.

Gamay Teinturier

Gamay Teinturier, a red European variety of medium vigour, bears large crops, which ripen in mid-season. The fruit splits and becomes mouldy in a wet season and it is susceptible to oidium in particular. The variety does well on 1202 stock. Because of its blood-red juice this variety is a useful blending variety for improving the colour of wines.

Cabernet Sauvignon

Cabernet Sauvignon is a red European variety of medium vigour and cropping ability. The berries, which are small, bluish black, thick skinned, and juicy, are loosely arranged in small clusters. It ripens in late mid season and is fairly resistant to wet weather. It is susceptible to all fungous diseases and requires frequent and thorough spraying.

It is valuable as a high-quality claret grape and is the basis of the renowned wines of the Medoc region, France. Cabernet Sauvignon produces wines with a beautiful colour and characteristic flavour. They are sharp and astringent when young, and require long ageing to reach highest quality. Cabernet Sauvignon blends well with the Pinots, the soft character of which tones down the Cabernet Sauvignon—one-third Cabernet and two-thirds Pinot make an excellent claret. Because of its late-ripening habit Cabernet Sauvignon should be grown on a sunny hillside.

At the Te Kauwhata Horticultural Station 50-year-old Cabernet Sauvignon vines on 1202 and 3306 stock cropped fairly well. This is an example of almost perfect affinity between stock and scion.

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Cabernet Sauvignon. Because of its late ripening habit this variety should be grown on a sunny hillside.

Precoce de Malingre

Precoce de Malingre is an early white European variety with a fairly vigorous manner of growth. The berries, which are oval and golden yellow, are loosely supported on the bunch. The variety is subject to fungous disease and the fruit cannot withstand wet conditions, though its early-ripening habit generally saves it from the latter.

The crops are very inconsistent, from poor to good in different seasons, as setting depends on warm, stable weather at flowering. At the flowering stage the inflorescences are subject to damage from thrips. A good affinity exists between this variety and 1202 and 3306 stocks.

It makes an excellent sherry or sweet white wine.

Goldriesling

Goldriesling, an early white European variety of fair vigour and fairly good cropping ability, has small, round, thin-skinned, yellowish-brown berries with a pronounced flavour on small, broad bunches. It is not particularly susceptible to fungous diseases and can be kept free of them by normal spraying procedure.

The fruit is fairly resistant to wet conditions, though the berries will split in an abnormally wet season. The variety does well on 3306 or 1202 stocks and makes a good white wine.

Chasselas Varieties

The Chasselas varieties are a group of white grapes with a number of sub-varieties, all of which ripen early, a maturing time which suits New Zealand conditions.

Chasselas Dore Salomon

A feature of Chasselas Dore Salomon is its large, loose bunches of round berries, which are larger than most wine-making grapes. It ripens early in March and regularly bears fair crops. It is more susceptible to oidium and black spot than to downy mildew and the fruit is fairly resistant to wet conditions.

Though Chasselas Dore Salomon is more suitable for table use than for wine making, a soft wine low in acidity and very suitable for blending to reduce the acidity of other grapes can be produced from it. It makes a pleasant sweet white wine, but the wine lacks character.

The variety does well on 1202 and 3306 stocks.

Riesling Sylvaner (Syn. Muller Thurgau)

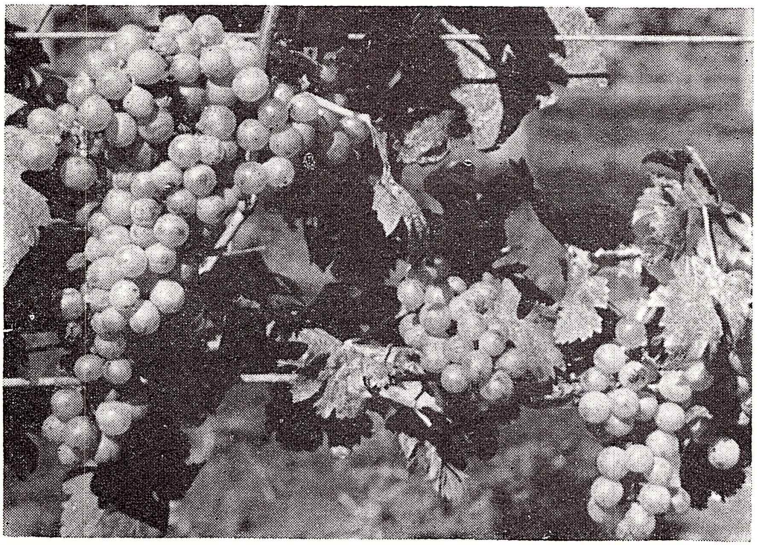
Riesling Sylvaner is a white European variety which displays good vigour of growth and good cropping ability. The berries are greenish-yellow with brown spots, thin skinned, and fairly fleshy and have a pleasant flavour. The bunch is moderately loose and the fruit withstands wet weather fairly well.

The variety is liable to attack from oidium, downy mildew, and black spot unless sprayed regularly. It crops consistently well on most soils, the grapes ripening about the middle of March. It makes a good dry or sweet white wine of low acidity. At the Te Kauwhata Horticultural Station it does well on 3306 stock.

This variety is grown fairly extensively in Germany, Austria, and Hungary.

Chardonnay

Chardonnay, sometimes called White Pinot, is a white European variety of average vigour. It bears medium crops which ripen in mid-season.



[*Sparrow*

Riesling Sylvaner, which makes a good dry or sweet white wine of low acidity.

The variety is susceptible to oidium and downy mildew and the resistance of its fruit to wet conditions is poor, being comparable with that of Pinot. The attractive golden berries, which are thick skinned, and juicy with a tart flavour, make an excellent chablis-type dry wine.

Because of the high quality of the wine made from it Chardonnay is worth persevering with in the drier parts where beverage, dry white wines are being produced. Chardonnay is grown extensively in the Burgundy and Champagne districts of France and produces the well-known chablis wine and champagne. It does well on 1202 stock.

Semillon

Semillon, a white European variety of average vigour, bears well and ripens in late mid-season. It is susceptible to black spot and to a less degree to oidium and downy mildew. The bunches are compact and small and the berries golden, fairly large, and fleshy with a pronounced, pleasant flavour when ripe. Unfortunately, like Chardonnay, the fruit is damaged by wet weather.

Either 3306 or 1202 is suitable as a stock for Semillon, which makes wine of very good quality.

In Australia Semillon is popularly known as Hunter River Riesling. Hock-type wines of considerable merit are made in the Hunter River district. Semillon is extensively grown in the Sauterne district of France, where it is highly esteemed as a white-wine grape and is used to make the well-known liqueur wine of that locality. There it is allowed to develop a botrytis mould, called noble rot ("pourriture noble"), that almost turns the berries into raisins which yield a very sweet juice necessary for the making of sauterne wine.

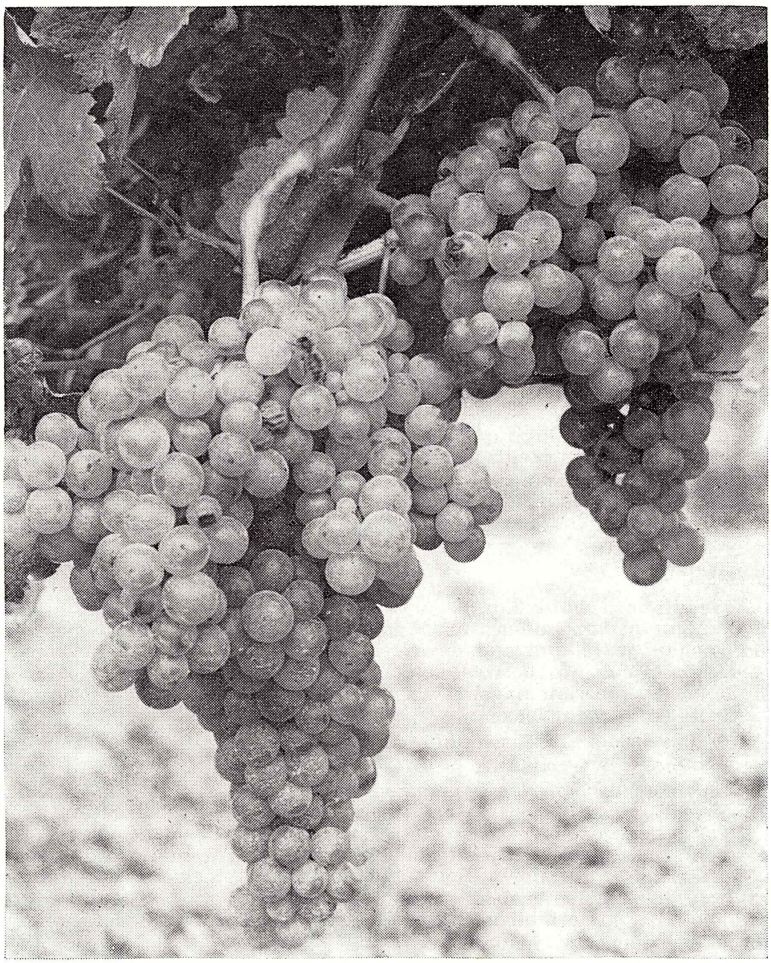
Gloriod

Gloriod, a vigorous white European variety, is also known as Gamay Blanc. At the Te Kauwhata Horticultural Station it bears large

crops, but its performance in Henderson and some other parts has been disappointing. It ripens its fruit in late March, which is a critical time, as wet weather at this stage causes the fruit to split, become mouldy, and drop.

The berries are pale yellow, thin skinned, and tightly packed in the bunch. The wine is of fair quality, but too high in acidity on its own.

Because Gloriod is rather late in maturing and the fruit is apt to be spoilt by rain, it is not a good variety for Auckland and North Auckland areas. In drier parts like Hawke's Bay it would be more reliable.



[*Sparrow*

Palomino is highly rated for production of sherry wine and brandy, and is also a pleasant dessert grape.

Palomino

A vigorous, productive, white *Vinifera* variety. The berries are medium sized, thick skinned, fleshy, and yellowish to golden. The bunches are large and well filled. Though it ripens late, the fruit can withstand wet weather. It is particularly susceptible to black spot. Palomino is a classical Spanish sherry variety and produces a good sherry-type wine under New Zealand conditions. When fully ripe it is a pleasant dessert grape. Recent distillation trials indicate that Palomino is a good brandy grape.

Dr Hogg Muscat

Dr Hogg Muscat is a white *Vinifera* variety which has fair vigour and produces good crops regularly. The berries are above average size, thick skinned, and fleshy with a pronounced muscat flavour. It is suitable for dessert. The bunches are large and loose. It is subject to black spot, but other diseases are not troublesome.

It ripens in mid-season and the fruit is fairly resistant to wet conditions.

It makes a pleasant wine with an attractive, muscat flavour. At Te Kauwhata it has done well on 1202 and 41B stock.

Pinot Gris

Pinot Gris has lost favour with most growers because of inconsistent bearing. It is still grown a little in Hawke's Bay and produces poor to medium crops according to the season. The bunches are typically Pinot type in appearance—small and compact—and the berries are a characteristic brown and ripen early. Pinot Gris produces high-quality white wine. The vine is a fairly vigorous grower and should be planted only on high ground. In humid, fertile positions very little fruit sets.

Red Dessert Varieties

Albany Surprise

See page 82.

Black Hamburgh

In New Zealand Black Hamburgh is grown mainly as an early glasshouse variety. It is a vigorous-growing European variety which ripens early in March. It is very susceptible to all fungous diseases and the fruit splits and rots in wet weather. It bears well in some localities and poorly in others. The proper setting of the flowers depends on dry, warm weather. In Auckland and North Auckland high humidity near the ground usually interferes with the setting on vines on a low trellis and vines are more fertile on a high trellis or pergola, preferably on high ground.

The berries are large, almost round, fleshy, and bluish-black with an attractive flavour when properly mature. The bunches are large and compact. Stock 3306 or 420A is recommended for the variety.

Black Hamburgh originated in Germany and is better known on the Continent as Frankenthal. There is a remarkable Black Hamburgh vine at Hampton Court, England. This vine, which was planted in 1769, now fills a large glasshouse, has a trunk 3ft. in circumference, and produces about 1,000 lb of grapes each year. The roots extend a great distance and are believed to go under the nearby River Thames.

Alphonse Lavallee

Alphonse Lavallee is a vigorous European variety which bears good crops which ripen in late mid-season. The bunches are big and loose and the berries large, round, and slightly oblate, fleshy, thick skinned,

and bluish-black. The variety is susceptible to all the fungous diseases; its resistance to wet weather is fair.

Alphonse Lavallee is an attractive-looking grape with a pleasant, almost neutral flavour which is not as good as that of Black Hamburgh.

It ripens later than is ideal, but by enclosing bunches in paper or transparent cellulose bags to protect them from birds and weather it is usually possible to ripen the fruit adequately even in a poor season. Well-grown Alphonse Lavallee grapes are as large as glasshouse Black Hamburgh, and because of their tough skin and fleshy nature they transport well.

The 1202 stock is suitable for Alphonse Lavallee.

Muscat Hamburgh

Muscat Hamburgh, a vigorous European variety, ripens in late mid-season. The cropping of this variety, also known as Black Muscat of Alexandria, is capricious.

The bunch and berries resemble those of Alphonse Lavallee, but closer comparison shows that the berries of Muscat Hamburgh are slightly lighter in colour and more egg shaped.

The variety is susceptible to all fungous diseases and is subject under certain conditions to shanking (withering of the pedicels attaching the berries to the bunch, which prevents normal ripening). The pedicels and stalks on this variety are very thin.

Muscat Hamburgh does not set fruit properly in humid conditions and should be grown on a high, well-drained position. It should not be planted in hollows or wherever the soil is damp and the air humid and stagnant. The resistance of the fruit to wet weather is fair.

The fruit, which has an excellent muscat flavour, is a good table grape. It makes a pleasant wine with a good muscat character. It does well on 3306, 41B, and 1202 stocks. Grafting seems to improve its performance.

Dolcetto

The fruit of Dolcetto, a vigorous European variety which crops well and consistently, ripens in early March. The bunches are large and loose. The berries, which are oval and medium to large, are dark blue. It is not particularly susceptible to fungous diseases and its fruit is fairly resistant to wet weather. The fruit is thin skinned, fleshy, and pleasant to eat.

Pink Dessert and Wine Varieties

Chasselas Rose Salomon (Chasselas Rose Royale × Fintendo)

Chasselas Rose Salomon is a fairly vigorous *Vinifera* hybrid of medium cropping ability which ripens about the middle of March. The bunches are medium to large and loose. Its handsome, large berries, which are light red and translucent, are thin skinned and juicy with a pleasant flavour. It is essentially a dessert grape.

It is fairly resistant to fungous diseases and wet conditions. A suitable stock is 1202.

Chasselas Rose Royale

A *Vinifera* variety Chasselas Rose Royale has fair vigour and medium cropping ability. Its fruit, which ripens about the middle of March, is fairly resistant to wet weather. In bunch and berry characteristics it is very similar to Chasselas Rose Salomon.

In addition to its other attributes the variety is fairly resistant to fungous diseases, which makes it a good table grape. *Mourvedre* × *Rupestris* 1202 is a suitable stock.

Ferdinand de Lesseps

Ferdinand de Lesseps is a hybrid with a precocious ripening habit, its fruit maturing in late February. This grape was obtained by crossing Golden Chasselas and Isabella.

The variety has medium vigour and cropping ability. Though rather susceptible to black spot and erinose, it is not much affected by downy mildew or oidium and its fruit is fairly resistant to wet conditions.

The berries, which are small, oval, pink to amber colour, thin skinned, and juicy, are arranged loosely on small bunches.

It is a pleasant eating grape with a distinctive flavour resembling that of its American Isabella parent. It makes a sweet white wine with a rich flavour and aromatic bouquet.

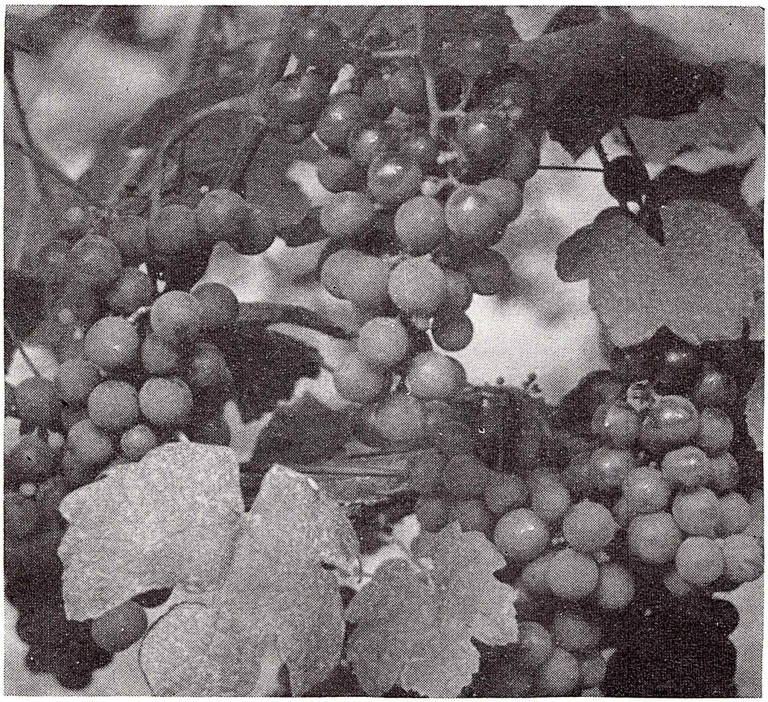
Plovak (Syn. Plovdiska, Pamit Rouge)

Plovak, a vigorous, precocious European variety, ripens in February. This ancient variety is grown extensively in inland European countries, where its short growing period is adaptable to the climate. Because it buds late, it misses severe frosts.

It is susceptible to downy mildew and oidium and the fruit splits in wet weather.

Its cropping ability is good. The berries are pink, oval, thin skinned, juicy, and medium. The bunches are medium and loose. It is a fairly good table grape, and makes wine of fair quality useful for blending because of its low acidity.

A suitable stock is 1202.



[*Sparrow*

Iona. This variety crops better in Hawke's Bay than in Auckland.

Iona *(Labrusca × Vinifera)*

Iona is a fairly vigorous grape which bears well and ripens in late March. It crops better in the lighter soils of Hawke's Bay than in Auckland. The bunches and berries resemble those of Chasselas Rose Royale and the fruit has a pronounced typical flavour, which is very agreeable.

It is resistant to fungous diseases, but the bunches are damaged by wet weather. It produces a pleasant wine of unusual character. The 1202 stock is suitable.

White Dessert Varieties

Madeleine Royale

A vigorous *Vinifera* variety with fair cropping ability, Madeleine Royale ripens about the middle of February.

The berries are medium, round, thin skinned, slightly translucent, juicy, and sweet with a delicious flavour.

Its bunches are medium and compact. As it is a tender grape, it does not carry well, but is a valuable grape for a local market.

It is fairly susceptible to oidium and downy mildew and the resistance of fruit to wet conditions is fair.

In overseas literature reports are very favourable on its wine-making qualities. It does well on 1202 and 3306 stocks.

Madeleine Alice Salomon

Madeleine Alice Salomon is a fairly vigorous *Vinifera* variety produced from a cross between Gros Colman (syn. Dodrelabi) and Madeleine Royale.

This is the most precocious variety grown in New Zealand and ripens in early February.

The berries, which are medium, round, thick skinned, fleshy, and an attractive golden yellow, are loosely arranged in medium bunches.

Its cropping ability is fair. Though fairly resistant to fungous diseases, it is sometimes affected by oidium if proper control measures have not been taken. The fruit splits and rots in wet weather. However, as February is usually fairly dry in most parts of New Zealand, there is less risk of damage than if the variety ripened later.

Both 1202 and 3306 have proved suitable stocks.

Chasselas Dore Salomon

See page 88.

Cannon Hall Muscat

Cannon Hall Muscat may be described as a sub-variety of Muscat of Alexandria, as it was selected from a seedling of the latter and cultivated because it ripened earlier (about the middle of March) than the former.

The berries, which are large, round, thick skinned, and amber coloured with a fine muscat flavour, are loosely arranged in large bunches.

It is susceptible to fungous diseases and the fruit is damaged by wet weather.

At the Te Kauwhata Horticultural Station it makes vigorous growth on 1202 and 41B stock.

Dr Hogg Muscat

See page 91.

Dattier de Beyrouth (Syn. Waltham Cross and Rosaki)

Dattier de Beyrouth is a vigorous *Vinifera* variety which ripens near the end of March. Its berries, which are large, oval, thick skinned, and fleshy, are a golden yellow. The bunches are very large and loose and its cropping ability is fair.

Dattier de Beyrouth is fairly susceptible to black spot, but resistant to downy mildew and oidium, and its fruit withstands wet conditions well. It is grown extensively in Asia Minor, where it is known as Tsarigrasko Grossde, for the production of raisins. In South Africa it is a well-known table grape under the name of Rosaki.

At the Te Kauwhata Research Station, Dattier de Beyrouth does fairly well on 1202 stock and is reported to have good affinity for most resistant-stock varieties.

In every respect this is a table variety deserving of more attention in New Zealand.

Muscat de Frontignan

Muscat de Frontignan is a European variety which displays rather weak growth at the Te Kauwhata Horticultural Station. Though its cropping ability and resistance to wet weather are fair, it is very susceptible to fungous diseases and erinose. The berries, which are small, round, thick skinned, and fleshy, are golden yellow and the bunches are small and moderately loose. The fruit, which has a good muscat flavour, ripens about the middle of March.

In other countries a pale-red variety is also grown. Both varieties have good wine-making qualities. The red variety was grown extensively in South Africa to make the well-known sweet constantia wine.

Both 1202 and 3306 stocks have an affinity with Muscat de Frontignan, but certain other stocks possibly may induce better performance.

Chasselas Persille (Parsley Leafed Chasselas)

Chasselas Persille is a vigorous European variety which ripens about the middle of March.

The berries are very similar in appearance to Chasselas Dore Salomon. The variety bears well and is fairly resistant to fungous diseases and wet weather. Chasselas Persille is a good white table variety worth cultivating and does well on 1202 stock.

Diamond (*Labrusca* × *Vinifera*)

Diamond is a vigorous and productive American hybrid which ripens about the middle of March. The *Vinifera* characters are wholly recessive in the foliage. It was produced from Concord seed fertilised by Iona.

The berries are large, oval, and greenish-yellow and have a pronounced *Labrusca* flavour.

It is fairly free from fungous diseases and the fruit is resistant to wet weather.

It is an excellent, hardy white table grape, though the smallness of the bunches detracts from its appearance.

Wine made from Diamond has the same peculiar exotic flavour as the grape.

Niagara (*Labrusca* × *Vinifera*)

Niagara is a white grape produced from Concord × Cassady and is mainly *Labrusca* in character. The vine, which is vigorous, hardy, and productive, ripens its fruit in the mid-season period. The berries are large in small, compact bunches and have a strong, aromatic flavour. It is resistant to disease and weather damage.

Baco No. 1 has proved an excellent stock for both Niagara and Diamond.

Though essentially a table grape, it produces a wine with a strongly spiced flavour, which appeals to most people unaccustomed to the more refined character of wines made from *Vinifera* varieties. Its wine is low in acidity and matures rapidly. A blend of wine made from Niagara or Diamond with other white varieties of more neutral flavour is rather attractive.

Other Varieties

Recent trials have demonstrated that Muscat Ottonel is a good, early-maturing white grape for producing a muscat wine or for dessert. Roter Traminer, a classical white table wine variety, and Pontac, an intensely coloured red wine grape, also performed well.

Trials have also shown the dessert varieties Cardinal, Keuka, Queen of the Vineyard, Athens, Schuyler, and Duchess are promising in New Zealand, while Pinotage, a red table wine grape, proved outstanding among varieties imported from South Africa.

Further trials are in progress with a range of varieties imported from France, Germany, Switzerland, U.S.A., and Australia.

Grapevine Varieties Available from Te Kauwhata Research Station, 1969

Cuttings of the varieties listed below may be bought from Te Kauwhata Research Station.

Agostenga
Albany Surprise
Aleatico
Alphonse Lavallee
Athens

Baco—1
Baco 22A
Barlinka
Bastado do Menudo
Bertille-Seyve 822
Bertille-Seyve 1127
Bertille-Seyve 3585
Black Prince
Bonardo
Bordelais
Boudales
Brocton
Brown Muscat
Buckland Sweetwater
Burdin

Cabernet Sauvignon
Cannon Hall Muscat
Cardinal
Catawba
Chardonnay
Chasselas Dore Salomon
Chasselas Rose Royale
Chasselas Rose Salomon
Chenin Noir
Cinsaut
Concord

Delight
Dolcetto
Donzellinho Gallego
Dr Hogg Muscat
Duchess
Dunkirk

Ezereves

Ferdinand de Lesseps
Fontan
Fredonia

Gaillard Girerd 157
Galibert 26111
Gamay de Beaujolais
Gamay Gloriod
Gamay Hatif des Vosges
Gloriod
Golden Chasselas
Golden Chasselas Salomon
Green Veltliner
Gros Maroc

Hanse Rose
Hermitage
Himrod
Humbert
Hungarian
Hungarian Green

Interlaken
Iona
I.P. 90
Italian No. 2
Italian No. 3
Italian No. 9
Italian No. 10

Keuka

Landot 244

Macabeo
Madeleine Alice Salomon
Madeleine Royale
Melegue 20458, 54093
Malvasia di Candia
Malvasia Fruher
Melascone Nera
Merlot
Meslier Rose
Mondeuse
Muscat Champion
Muscat Chasselas
Muscat de Frontignan
Muscat Early
Muscat Golden Queen
Muscat Hamburgh
Muscat I.P.
Muscat I.P. 24
Muscat of Alexandria
Muscat Ottonel
Muscat Salomon
Muscat Verdea
Muscat White
Muscato Bianco
Muscato Bianco Precocissimo

Neuburger
New York Hybrid
Niagara
Oberlin 595

Ontario
Othello

Palomino
Parsley Leafed Chasselas
Patte d'Oie
Pearl of Csaba
Pedro Ximines
Pinard
Pinotage
Pinot Blanc de Bronner
Pinot Blanc Hatif
Pinot Gris
Pinot Meunier
Pinot Noir Am 105
Pinot Noir Bachtobel
Pinot Noir Oberlin
Pinot Noir Reveney
Pinot St Laurent
Pirovano
Plovak
Pontac
Portugais Bleu
Poulsart
Poulsart Blanc
Princess Muscat

Queen of the Vineyard

Grapevine Varieties (continued)

Ravat 6
Red Muscadel
Regina
Rhine Riesling
Richter
Riesling Italia
Riesling Sylvaner
Romulus
Roter Traminer
Ruby Cabernet

Sauvignon Blanc

Schuyler
Seibel 4121, 4615, 4633, 4643, 4762, 4986, 4995, 5368, 5409, 5437, 5455, 5487, 5860, 6339, 7052, 7053, 8764, 10096, 10146, 10868, 10878, 11803, 12053, 12583, 13053, 13666, 14117, 14177, 14287, 16050
Semillon
Seneca
Sultana

Seyve-Villard 3160, 5276, 19410

Tokay Furmint
Traminer Rose

Van Buren
Volta

Waltham Cross
White Diamond
White Muscadel

ROOTSTOCKS

Berlandieri × Riparia 420A
Bourrisquon × Rupestris 93-5
Mourvedre × Rupestris 1202
Riparia × Rupestris 3306
Teleki 8B

VIRUS-FREE ROOTSTOCKS

Rupestris St. George
1202
1613
ARGI
Kober 5BB

VIRUS-FREE SCION CUTTINGS

Gewurz Traminer
Baco 22A

Printed by the "Evening Post" Ltd., Wellington, by authority A. R. Shearer,
Government Printer.